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WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING, PRODUCING,
PIPE LINE OPERATIONS AND MANAGEMENT

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smooth pipe handling
on round trips

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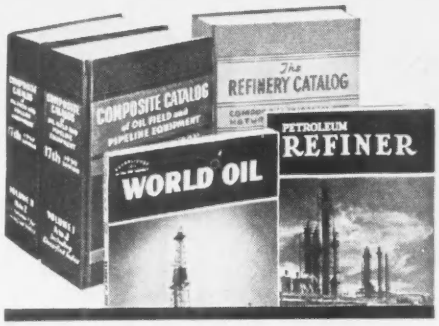

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for the drilling-producing-pipe line industry

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for the refining-natural gasoline industry

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Coming up . . .

The 1951 REVIEW-FORECAST Issue

This special issue of WORLD OIL will bring you a complete review of 1950—plus forecasts for 1951. You can get a personal copy by using the coupon on page 291.

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Looking Ahead

OIL INDUSTRY EARNINGS outlook for 1951 is favorable, as war situation foreshadows large demand for petroleum and strong prices. Industry's earnings for 1950 will be about 18 percent above 1949 but 17 percent under record net income of 1948, Chase National Bank has forecast, making no allowance for retroactive excess profits tax. Though oil consumption of 1950 set record, refined product prices were under 1948.

INDEPENDENT PRODUCERS, after calling off the dogs on imports, due to Korean War, glumly watch imports rise, expect rate of more than 1 million barrels a day in 1951, and warn that excessive imports endanger domestic markets and development and threaten national security program. Imports lately have exceeded 900,000 barrels daily, and Bureau of Mines forecast 922,000 daily in first quarter 1951.

PROJECTED FOREIGN PIPE LINE CONSTRUCTION with scarce U.S. steel may encounter serious obstacles. Already short of pipe, domestic operators publicly question whether U.S. government should permit shipment of large tonnages for big pipe lines in Middle East and Venezuela. Projected new lines include a 30-inch from Iraq to Mediterranean, a 150-mile 30-inch from Lake Maracaibo fields to deep water, and a proposed 800-mile 34-inch line from Iran and Kuwait to Mediterranean.

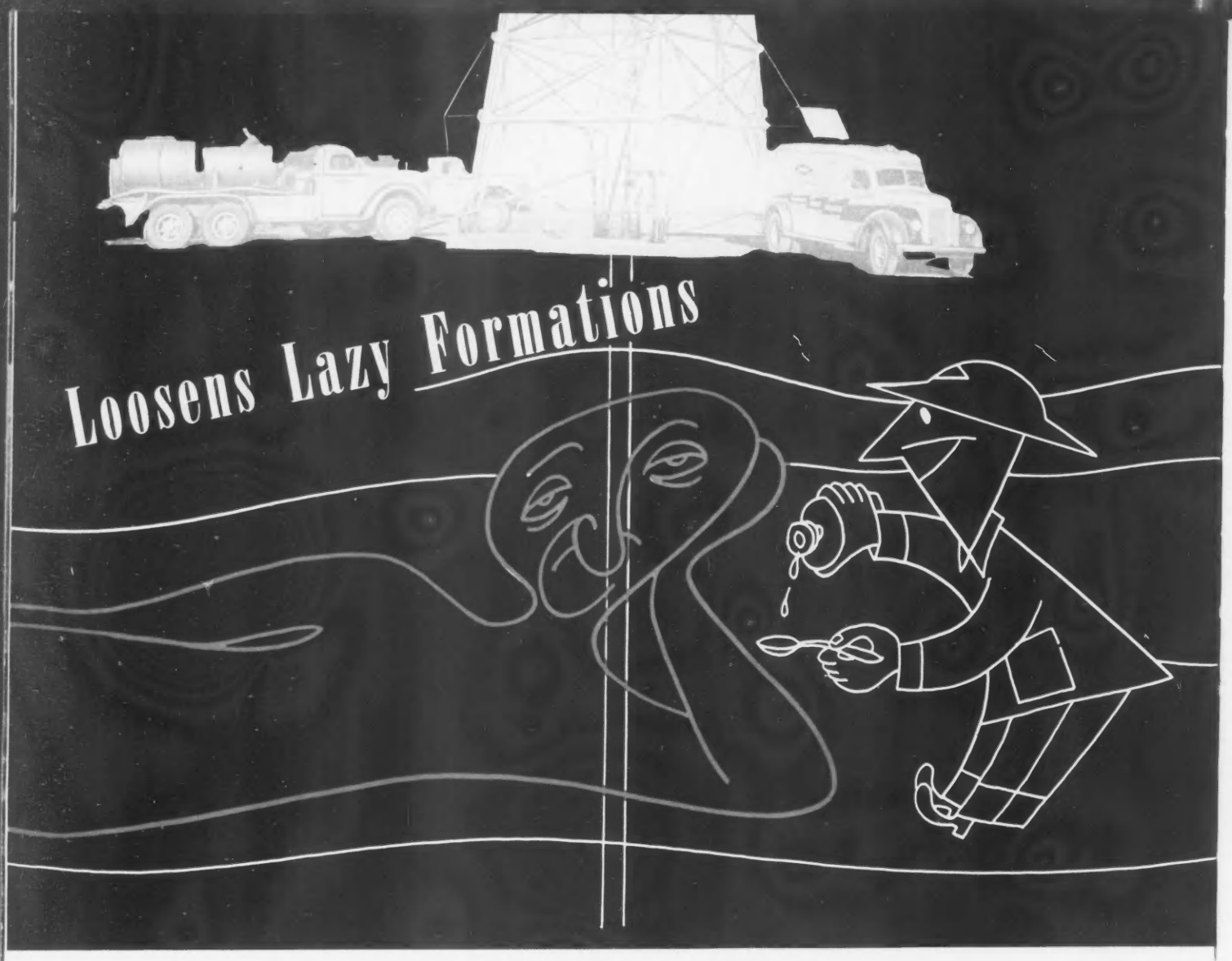
NATURAL GAS WILL BEGIN supplying New England areas by next September, on completion of pipe line by Tennessee Gas Transmission Company.

INCREASED AND MORE DARING WILDCAT DRILLING on "More Imaginative Prospects" not only can but must be "afforded" by the petroleum industry in order to meet relentlessly expanding demand for oil, declared Ira. H. Cram, vice president, Continental Oil Company, at regional meeting of Society of Exploration Geophysicists at Fort Worth. (See page 68).

THERE IS NOW ENOUGH imported crude rubber and American rubber producing capacity within U.S. borders to meet military demands for a five-year war and at same time supply rubber for essential civilian uses, recently stated John L. Collyer, president of B. F. Goodrich Company. U.S. consumed total of 1,240,000 long tons of rubber in 1950, will need less in 1951, and output of American-made should reach rate of 925,000 tons annually early in 1951.

U.S. PRODUCTION OF DEFENSE ALUMINUM will be boosted by 25 percent through two major programs of Aluminum Company of America. A "quickie" plan shortly will add 158 million pounds to annual output, using already existing standby facilities at Massena, N. Y., and Badin, N. C., that require high-cost electric power. Second project is an expansion plan involving erection of permanent new capacity for producing 240 million pounds per year. Smelting facilities at Point Comfort, Texas, plant will be enlarged, and a new plant will be built, using electric power generated from gas or coal.

WITHIN TWO YEARS huge quantities of the new wool-like petroleum synthetic textile commonly called Orlon will be manufactured. Men's suits made of Orlon will never have to be sent to cleaners, having a permanent crease and only needing to be rinsed out to clean.



DOWELL SELECTIVE ACIDIZING opens up the tight zones —has made profitable producers out of many a sick well

The acidizing of the *right* zones in a well is often the key to a successful workover or completion. When Dowell engineers use the Electric Pilot to acidize your well *selectively*, treatment is held to the *right* zones.

A well was producing 96 bbls. of oil per day with a gas-oil ratio of 31,000 cu. ft. per barrel. Dowell engineers correlated an Electric Pilot Permeability Survey with other well data and recommended that the lower 3 ft. of a 13 ft. pay be acidized *selectively* with the Pilot. Following the treatment, production increased to 960 bbls. of oil per day and the gas-oil ratio dropped to 2000 cu. ft. per barrel!

Selective acidizing is useful in most old wells, particularly those with residual oil in tight sections; those with high gas-oil ratios, or intermediate water zones; and those plugged back from bottom water or deepened to new pay zones. It is of value for new wells with saturated zones of varying permeability and those with a change of formation within the open hole.

For additional information about selective acidizing and the other Dowell Electric Pilot Services, call your nearest Dowell office.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
SELECTIVE ACIDIZING

Ask your nearest Dowell station for complete information on these Dowell services and **products:** Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale **Removal** Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium **Anodes** for corrosion control, and Bulk Inhibited Hydrochloric Acid.

Promotes Progress"

Look to **DOWELL**

FOR OIL INDUSTRY CHEMICAL SERVICE

AGAIN WE SAY: PUBLIC RELATIONS PROGRAM PAYS

LAST month the Editor of WORLD OIL, on "Editor's Page," said the public relations program of the oil industry is paying off in a better understanding of the industry by the public. He gave figures to prove that this better understanding was of considerable proportions.

When the program was first sponsored by The American Petroleum Institute, there were some elements within the industry who scoffed at the idea under the impression that the big oil companies were just selling the public a bill of goods. In fact, one Texas independent with a cynical expression used almost those exact words to the writer, and implied that no one other than a major company had a stake in seeing the campaign successful.

We suspect that even this cynical operator has changed his mind.

The campaign has proceeded upon the perfectly sound basis that where there is understanding, the chaotic fruits of misunderstanding will be few. The oil industry has made a genuine endeavor to cure some bad misunderstandings on the part of the public. Misunderstandings, in some instances deliberately created, are fostered by people who are not friendly or even tolerant toward any elements within the industry; large, intermediate or small. Because even despite the sorry spectacle attendant these days upon the movement of some countries into the socialistic orb, there are, here in the U. S., many who would like to see all phases of the industry taken away from individuals and taken over by federal bureaus.

The entire industry has benefited from the program of information which has been under way now for three years.

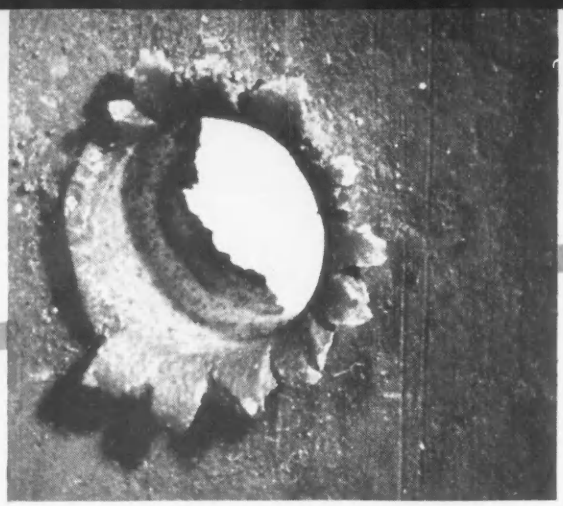
Last month WORLD OIL's editor named four immediate problems facing the American oil business in Congress, problems on which the public relations program should have an important bearing. On every one of the four, the interest of the large company and the small company, as well as the public, are identical.

Let there be no slackening of interest or effort on the part of anyone within the oil industry, from company president down to the lowest paid employe, in making this oil industry campaign of information successful.

In case the reader of this editorial is the holder of a very unimportant position within the oil industry, let him remember that under government monopoly (the Post Office Department is a perfect example), the individual would be worse off than he would be under private enterprise.

Ray L. Dudley

DANGER

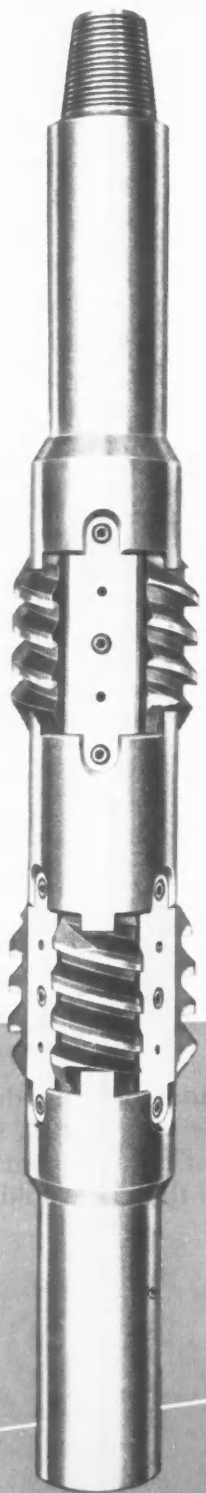


DO NOT RUN packers, testers, swabs or retainers

...until the "working surface" of your casing is clean

This typical burr resulting from a gun-shot hole, clearly shows why so many operators always consider it a "must" to clean the WORKING SURFACE—the vital inner wall of casing—with the new Baker ROTO-VERT Casing Scraper.

It is easy to see why tools with rubber cups, or a rubber packing element, many times fail to set properly, and often are cut, torn and hopelessly damaged while running-in the well. Ninety-nine times out of a hundred, premature setting of packers, testers and retainers, or their failure to effect a leak-proof pack-off, is due *not* to faulty construction or operation of the tool, but to burrs, cement, hardened mud, or other obstructions which . . . PREVENT PASSAGE OF THE SLIPS • CUT OR OTHERWISE DAMAGE THE PACKING ELEMENT; *or* • PRESENT SUCH A ROUGH, UNEVEN SURFACE THAT A LEAK-PROOF PACK-OFF IS IMPOSSIBLE.



The new Baker Model "C" ROTO-VERT Casing Scraper is a helix-blade-type scraper which can be either rotated or "spudded" (reciprocated vertically) for the removal of perforation burrs, imbedded bullets, cement sheath or other obstructions from the inner wall of casing. The body is machined from bar stock, with two sets of machined (not cast) blades positioned for overlapping, 360-degree scraping coverage.

The direction and angle of shear of the deeply hard-faced cutting edges is *exactly opposite* from other helix-blade-type scrapers, which means that the scraping edges of the ROTO-VERT will not "screw down" past burrs, but will actually *shear away* burrs, cement and other obstructions.

CHOOSE THE BAKER CASING SCRAPER EXACTLY RIGHT FOR YOUR WORK

The new ROTO-VERT Scraper is at its best where hundreds of burrs, with possible imbedded bullets, or unusually long stretches of hardened cement must be removed. It operates successfully *with* or *without* rotary equipment.

For normal scraping, where rotary equipment is present, the time-tested Baker Model "B" Casing Scraper, Product No. 620-B, continues the popular choice of many operators.

Why not get in touch with your nearest Baker representative and secure specific recommendations for your next job? Or send for the new illustrated 28-page booklet which contains complete information on the important subject of Casing Scraping the Baker Way.

BAKER OIL TOOLS, INC.

Houston • Los Angeles • New York

BAKER
MODEL "C"
ROTO-VERT
CASING SCRAPER
PRODUCT NO. 620-C

Scrapes the "WORKING SURFACE" of your casing CLEAN and SMOOTH

The Changing Panorama

Oil Lands for Truman; Was it a Fair Deal?

THE PEOPLE of Texas and Louisiana are in the process of getting a part of the Fair Deal they asked for in strongly helping to elect President Truman, as the federal government proceeds with the grab of the tidelands.

In a final decree December 11, the Supreme Court gave the U. S. full dominion over Texas and Louisiana tidelands and required that the two states give the federal government an accounting of all monies derived from leases since June 5, 1950, date of its decision sustaining U. S. claims. The government had asked an accounting from June 23, 1947, date of the California tidelands decision. The court's decision in favor of the later date was estimated to have saved Texas about $8 million and Louisiana about $35 million.

After the decision, Secretary of Interior Chapman authorized continuation for 60 days of oil and gas operations in the Gulf under state leases, and advised operators they could submit requests within 30 days for further extension. The operators henceforth must pay rentals, royalties, and other payments to the U. S. Authorization of continued operations under state leases is not to be construed, he said, as "an adoption, confirmation, ratification, or validation of said leases by the U. S., and is without prejudice to any rights of the U. S."

Before the last presidential election, President Truman vetoed a bill that Congress had passed, recognizing states' rights to the tidelands. The Republican platform in 1948 committed that party to recognition of state claims to the submerged lands. Texas has been deprived of these public lands in spite of a treaty with the U. S. on annexation, specifically retaining all public lands because of also retaining Texas public debt.

The only hope of Texas and other coastal states for regaining tidelands is that of action by Congress such as it took previously, declaring ownership of the submerged coastal lands by the states. With Truman as president, such a bill would be vetoed, and the two-thirds majority for overriding the veto would be hard or impossible to get.

It is to be expected that efforts to pass federal quitclaim legislation will be made again in the new Congress, under sponsorship of coastal states. Proponents of states' claims declare that not only coastal states but all others as well have much at stake in this matter, since similar action could be taken by the U. S. government in taking over for itself the rivers, streams, lakes, harbor facilities, and other state and municipally owned properties, under pretext of national security or national welfare reasons. Furthermore, it is warned, the tidelands action even jeopardizes private property rights, setting a precedent and enunciating a principle under which the federal government might declare a privately owned mining property, electric power system, pipe line, or oil field essential to the government for national security reasons.

For national defense, the tidelands have been made less likely to contribute any material amount of oil, because the tidelands cases definitely have retarded offshore exploration and development. A recent count showed only 14 drilling rigs active on Gulf Coast offshore locations, and all were in the several established offshore fields, not a single one having been on a wildcat location. One year previously, before the U. S. Supreme Court decision giving "paramount rights" over the tidelands to the federal government, there were 20 active rigs in the Gulf, of which 14 were wildcats.

Military Still Takes Small Part of Supply

MILITARY DEMAND so far has not had a large effect on the over-all demand for petroleum products, and the industry remains below capacity operation even after meeting stepped-up industrial needs since mid-1950, Robert E. Wilson, chairman, and A. W. Peake, president, Standard Oil Company (Indiana), told stockholders.

The new demand has been particularly concentrated in two fields: high octane aviation gasoline and lubricants for both industrial and military purposes.

Defense Planned for Personnel, Property

OIL COMPANIES individually and through The American Petroleum Institute are devoting study and planning toward protection of properties and personnel, in the U. S. as well as foreign areas, in event of war.

More than 20 companies are represented on an API committee which is working on a program to be offered to the industry for the defense and protection of plants and workers. As a foundation for the program the committee is adopting the plans that were used successfully during World War II.

Apparently, there is more fear among Americans now than ever before that continental U. S. could be successfully attacked in event of war. The greater anxiety presumably is based on possibilities raised by guided missles, atomic bombs, increased ranges of aircraft, and the limited progress of the U. S. toward mobilization.

An example of what oil companies are doing individually in regard to war hazards may be seen in a recent statement of Socony-Vacuum Oil Company to stockholders.

"Some of our stockholders have asked what the company is doing to protect its employes, its plants and records should war spread to this country," the report stated. "Actually, the nature of our widely dispersed operations is such that any additional protection called for is pretty much in line with our normal routine. For years practically all of our major installations have been staffed with full time safety and plant protection experts.

"Now we have a special group constantly studying supplementary security measures which changing situations may suggest," the statement continued. "Involved in all this are, of course, plans for the maximum safety of our personnel and the communities in which they work, anti-sabotage measures, the duplication away from congested areas of important records, and the coordination of our programs with those of federal and state civilian defense agencies."

Report from the Observatory

Oil Outlook Good

By RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

THE OUTLOOK for oil is good, recent events presaging increased consuming rates which in turn should require enlarged producing and refining levels within a few months. Currently, the industry is in a strong economic position with a favorable balance between supply and demand, so the problems ahead will consist of those created by the shift to a national emergency footing. It will be necessary to adjust product yields to provide military needs, but if given enough steel and manpower to maintain operations at high volumes the industry should be able to expand its production, refining and transportation facilities sufficiently to fulfill requirements during 1951.

With a record number of vehicles and fuel furnaces in use and the U. S. preparing to rush to an emergency defense basis, demand for oil seems certain to continue upward from present peak volumes as the country's mobilization program grows in size. Even without actual all-out warfare, scheduled enlargement of industrial armament activity and military training presage greater consumption of petroleum products in the months ahead. The only possible hitch is that civilian usage might be reduced sufficiently to offset increased industrial and military demand, but this seems unlikely unless an unexpected acute shortage develops causing stringent rationing.

• • •

HIGHER PRODUCTION will become necessary when the military and rearmament programs get into action because stocks need to be maintained near present seasonal volumes. In contrast with somewhat excessive inventories at the start of 1950, crude and fuel oils have been reduced to the point inventories are no more than needed. Gasoline is the only product now stored in larger amounts than a year ago.

Crude stocks were 10 million barrels under last year's levels and 28 million barrels less than 18 months previous in totaling 246 million barrels in mid-December. They can be reduced only slightly below this level without becoming dangerously small. Therefore, production must be at sufficient rates to fulfill existing needs.

Refined product stocks also reflect the dependence on current production. With the exception of gasoline, refined product inventories are under year ago volumes and should not be reduced further.

With the first severe cold weather of the year experienced in the Midwest and North Atlantic Seaboard areas, distillate fuel oil inventories dropped sharply during recent weeks. In the month ended December 16 distillate stocks declined by 10 million barrels, and the 77 million barrels in storage on the later date were 5½ million barrels below year ago storage. Only the fact that stocks in the heaviest consumption regions—east of California—are but 2 million barrels under 1949 levels keeps distillate inventories from being considered inadequate.

Meanwhile, residual fuel stocks are 21 million barrels below last year levels and growing military shipping is boosting demand.

Gasoline stocks currently are 2½ million barrels above 1949 levels in totaling 111 million barrels, and probably will rise to an all-time peak of 140 million barrels before the motor fuel consuming season starts in April. The gasoline problem always is with the industry during this season of the year, and in view of the high demand and prospects of additional growth these inventories do not appear enough out of line to be alarming.

• • •

PRICES ARE STRONG all along the line and were tending upward during early December in view of the favorable general outlook for the industry. Only the gasoline market was quiet. Premiums generally were being quoted for fuel oil, while advances were posted for California heavy fuel oil, Pennsylvania and California crudes.

This situation was causing talk of a general widespread crude price advance, when the Economic Stabilization Agency asked 40 U. S. refiners to hold prices at the December 8 level (see story page 32).

NEW CRANE CLASS 600 PIPE LINE GATE VALVES GIVE YOU MANY ADVANTAGES

EASIER OPERATION

TIGHTER SEATING

SMOOTH, CLEAR FLOW

COMPLETE GREASE SEALING

PROTECTED SEATS

For smoother, unrestricted flow . . . for easier, positive operation . . . these new Crane valves are outstanding performers. Developed especially for oil and gas pipe lines, they incorporate many improvements that add up to more years of maintenance-free, fully dependable service. The following are typical advantages of Crane design.

STREAMLINE FLOW—Disc ports align with seat openings to provide smooth passageway when valve is fully open. No turbulence. Least possible resistance to flow. No pockets to accumulate dirt.

LUBRICATED WORKING PARTS. Body packed with grease to reduce friction and wear of internal parts. Grease provides seal at seats, bonnet joint, and stem, which helps maintain pressure tightness.

DUAL-SEATING DOUBLE DISC wedges tight both in fully open and closed positions. Seals off grease from line fluid; protects disc seating surfaces when valve is open.

ACCURATE DISC GUIDING assures correct seating and prevents cramping or binding the stem.

PRESSURE-TIGHT BOLTED BODY-BONNET JOINT. Line pressure forces synthetic rubber "O" ring gasket into wedge-shaped groove in body flange and helps keep the joint tight.

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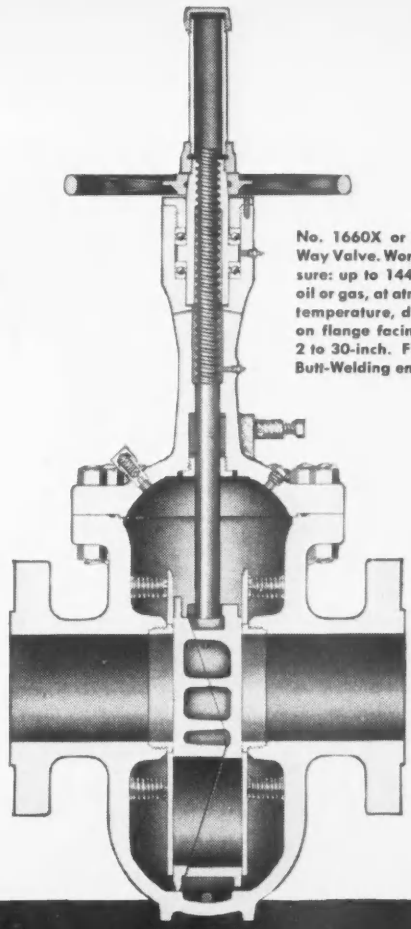
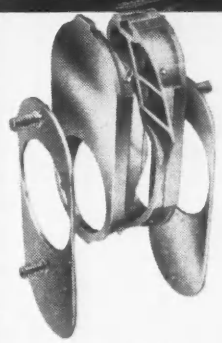


No. 1660X or XH, Full-Way Valve. Working Pressure: up to 1440 pounds oil or gas, at atmospheric temperature, depending on flange facing. Sizes: 2 to 30-inch. Flanged or Butt-Welding ends.

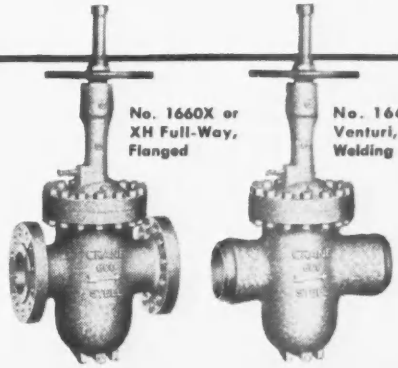
HOW THEY OPERATE



Double disc wedges tightly against shoulder type body seat rings in both open and closed positions. This protects seat faces from erosion and wear.

Movable spring-loaded plates, shown here, retain grease in body and bonnet while valve is being operated . . . also close "conduit" openings in disc against entrance of grease when valve is partly or fully closed.

Only one half of disc is attached to valve stem. At both ends of its travel, the unattached half of the disc comes in contact with stops. Additional wheel rotation then moves the stem-attached half of the disc farther, forcing both discs outward against seat rings and wedging them there.



No. 1660X or XH Full-Way, Flanged

No. 1665XH Venturi, Butt-Welding

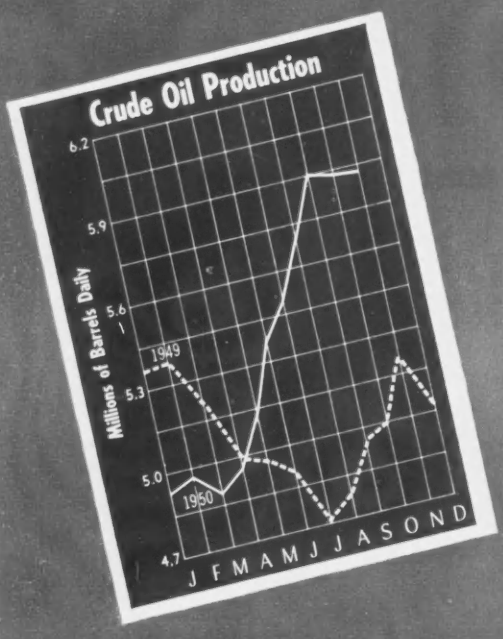
EVERYTHING FOR EVERY PIPING SYSTEM

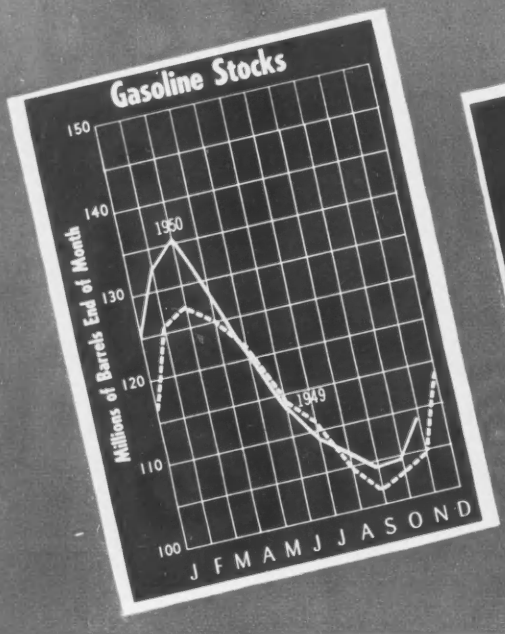
CRANE

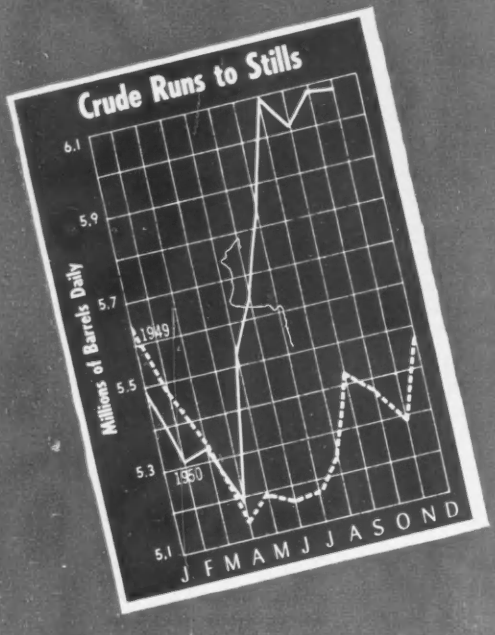
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

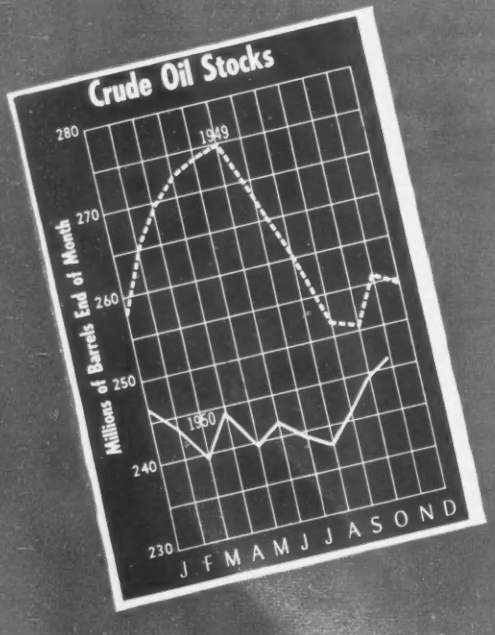
Petroleum

By CECIL W. SMITH
Statistical Editor







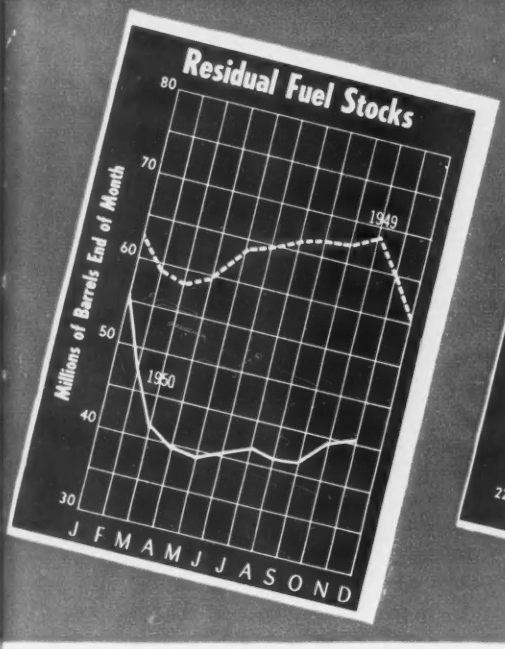


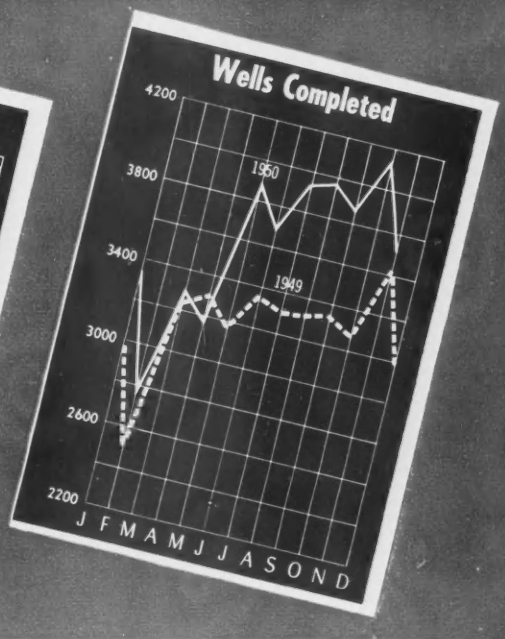
STATE CRUDE OIL PRODUCTION

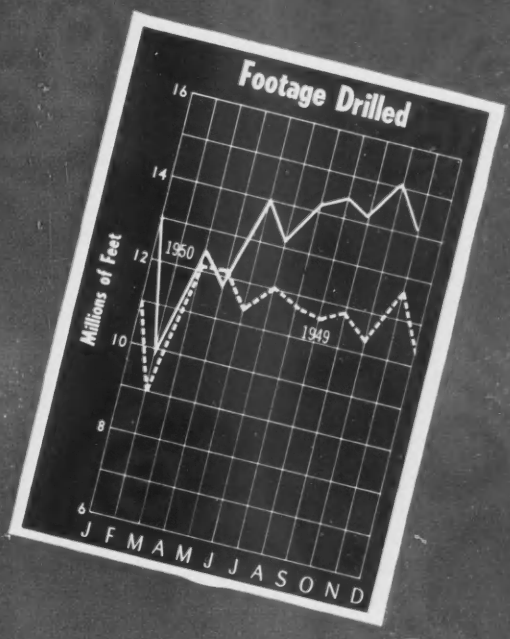
(THOUSANDS OF BARRELS)

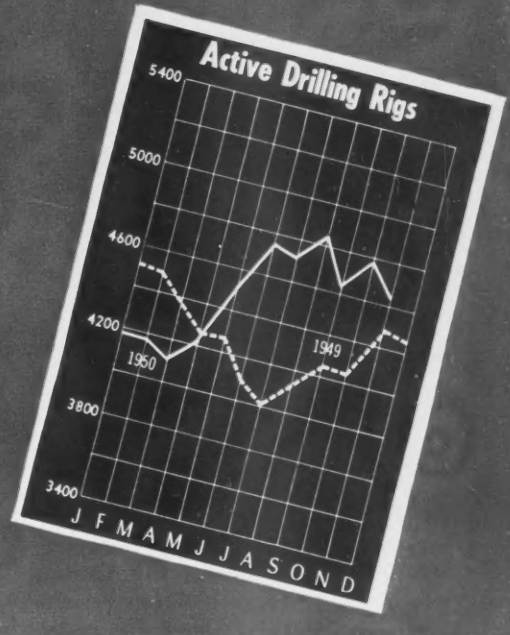
STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST 11 MONTHS		
	Nov., 1950	Oct., 1950	Nov., 1949	% Diff. Nov., '49-'50	1950	1949	% Diff. '49-'50
Alabama	2.4	2.3	1.4	+ 71.4	642	413	+ 55.4
Arkansas	85.8	86.5	85.0	+ 0.9	28,661	27,296	+ 5.0
California	957.7	943.2	871.6	+ 9.9	297,703	305,918	— 2.7
Colorado	76.7	70.4	65.9	+ 16.4	21,076	22,144	— 4.8
Florida	1.7	1.5	1.0	+ 70.0	442	412	+ 7.3
Illinois	174.5	179.2	181.1	— 3.7	57,395	59,103	— 2.9
Indiana	30.0	30.9	29.7	+ 1.0	9,278	8,662	+ 7.1
Kansas	303.9	304.3	288.4	+ 5.4	98,306	93,199	+ 5.5
Kentucky	29.7	29.0	26.3	+ 12.9	9,271	7,876	+ 17.7
Louisiana	607.4	604.4	552.3	+ 10.0	190,285	173,644	+ 9.6
North Louisiana	125.2	126.2	124.4	+ 0.6	40,871	40,673	+ 0.5
South Louisiana	482.2	478.2	427.9	+ 12.7	149,414	132,971	+ 12.4
Michigan	42.7	42.2	45.6	— 6.4	14,634	15,026	— 2.6
Mississippi	107.8	111.0	100.6	+ 7.2	35,097	34,916	+ 0.5
Missouri	0.1	0.1	0.1	....	27	43	— 37.2
Montana	23.3	22.3	24.2	— 3.7	7,389	8,445	— 12.5
Nebraska	5.3	4.1	1.4	+278.6	1,142	280	+307.9
New Mexico	129.5	130.3	131.9	— 1.8	43,546	43,879	— 0.8
New York	14.0	14.1	11.1	+ 26.1	3,975	3,899	+ 1.9
Ohio	8.3	9.6	9.4	— 11.7	3,100	3,155	— 1.8
Oklahoma	492.6	483.3	433.4	+ 13.7	149,075	138,681	+ 7.5
Pennsylvania	30.3	32.4	29.5	+ 2.7	10,741	10,458	+ 2.7
Tennessee	0.1	0.1	0.1	....	20	18	+ 11.1
Texas	2,577.5	2,607.1	2,180.8	+ 18.2	754,130	681,377	+ 10.7
Dist. 1—South Central	31.2	31.1	27.3	+ 14.3	9,493	8,883	+ 6.9
Dist. 2—Middle Gulf	151.1	152.7	133.1	+ 13.5	44,539	43,855	+ 1.6
Dist. 3—Upper Gulf	463.0	470.2	415.8	+ 11.4	137,933	133,208	+ 3.5
Dist. 4—L. Gulf-S.W.	232.4	236.5	205.3	+ 13.2	69,933	66,111	+ 5.8
Dist. 5—East Central	43.0	43.1	37.5	+ 14.7	11,946	12,500	— 4.4
Dist. 6—Northeast	392.5	401.5	365.9	+ 7.3	120,406	117,567	+ 2.4
Dist. 7-B—N. Central	72.4	78.4	63.1	+ 14.7	23,019	20,244	+ 13.7
Dist. 7-C—West Central	79.3	77.4	54.9	+ 44.4	20,784	15,584	+ 33.4
Dist. 8—West	872.6	872.0	639.6	+ 36.4	241,365	192,498	+ 25.4
Dist. 9—North	150.0	154.2	143.6	+ 4.5	48,139	45,030	+ 6.9
Dist. 10—Panhandle	90.0	90.0	92.3	— 2.5	30,363	30,391	— 0.1
Utah	3.2	3.4	2.4	+ 33.3	1,075	374	+187.4
Virginia	0.1	0.1	0.1	....	22	40	— 45.0
West Virginia	6.6	8.0	8.2	— 19.5	2,580	2,597	— 0.7
Wyoming	171.4	164.3	128.0	+ 33.9	54,222	42,698	+ 27.0
Total United States	5,882.6	5,884.1	5,209.5	+ 12.9	1,793,834	1,684,553	+ 6.5

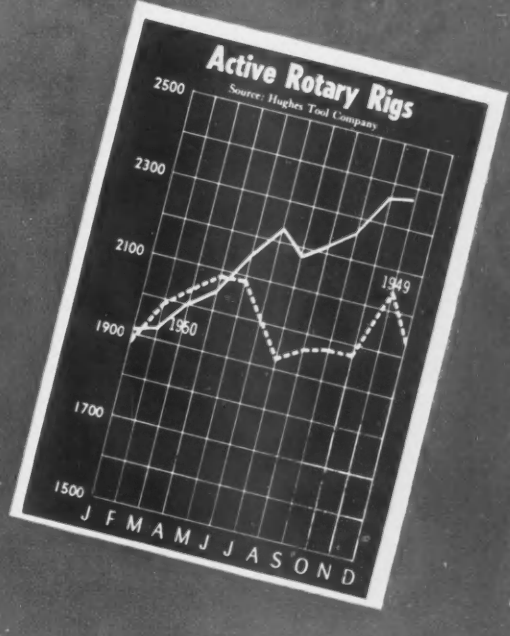
Trends in the U.S.











Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
September	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58,082
October	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December	5,688	5,720	256,254	2,626	103,697	1,166	71,475	1,299	64,021
1949:									
January	5,265	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190
April	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084
August	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843
September	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117
October	4,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673
November	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112
December	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60,193
1950:									
January	4,922	5,483	246,610	2,575	125,298	1,048	63,932	1,209	55,808
February	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828
March	4,878	5,336	241,098	2,539	133,766	938	37,777	1,154	41,860
April	4,968	5,193	244,605	2,508	128,057	977	37,530	1,048	39,979
May	5,143	5,535	239,877	2,647	121,035	997	42,739	1,063	39,482
June	5,378	5,655	242,287	2,748	114,074	1,037	53,679	1,069	40,124
July	5,484	5,882	240,270	2,835	111,055	1,040	62,555	1,140	42,165
August	5,665	6,067	237,393	2,932	107,067	1,089	68,426	1,148	40,979
September	5,888	6,059	242,311	2,849	105,748	1,180	78,270	1,178	41,966
October	5,884	6,089	244,860	2,844	104,757	1,213	85,269	1,205	44,472
November	5,883	6,081	246,818	2,825	108,628	1,215	85,427	1,225	45,320
Nov., 1950 Change:									
In Month	−1	−8	+1,958	−19	+3,871	+2	+158	+20	+848
In Year	+673	+788	−9,192	+231	+3,921	+253	−2,785	+45	−19,792
Week Ended:									
Dec. 16, 1950	5,723	5,925	247,274	2,928	110,943	1,266	76,913	1,224	41,598
Dec. 17, 1949	5,000	5,389	257,976	2,618	108,490	1,038	82,450	1,151	62,786

Monthly News Analysis

Industry Controls Not In Sight, Says Brown

Mandatory controls on the oil industry are not now in sight, according to Deputy Petroleum Administrator Bruce K. Brown. He emphasized that there were no limitation orders contemplated even for tetraethyl lead or the regulation of materials.

However, Brown said, this anticipates that the petroleum industry can supply the products needed. If shortages develop, a regulatory system will become necessary. In time the need may become acute for a priority system, Brown said, but such an arrangement is not now planned.

Creation of Petroleum Administration for Defense will leave National Petroleum Council functioning as usual, although the Interior Department's Oil & Gas Division is being reduced drastically and many of its key men are already transferred to PAD. The Oil & Gas Division will be limited to handling the Connally Law and problems of leasing, and will be under C. G. Davidson, Assistant Secretary of the Interior.

National Petroleum Council's committee on organization structure under the Defense Production Act has recommended that NPC as now constituted "can perform the functions now being carried out and in addition thereto could perform the industry advisory committee duties contemplated under the Defense Production Act. With the possible exception of representatives of manufactured gas, the council consists of a fair representation for independent, small, medium and for large business enterprises, for different geographical areas, for trade association members and non-members, and for different segments of the oil and gas industry."

Top Administrators for PAD Staff Selected

Top administrative staff for Petroleum Administration for Defense (PAD) has been virtually completed, although technical personnel will be added during the next few months. The present composition of PAD, headquartered in the New Interior Building at Washington, is as follows:

Petroleum Administrator for Defense—Secretary of the Interior Oscar Chapman.

Deputy Petroleum Administrator—Bruce K. Brown, president of Pan-Am Southern Corporation, a Standard Oil Company (Indiana) affiliate.

Assistant Deputy Administrator—Hugh A. Stewart, who also continues as head of the Oil & Gas Division of the Interior Department.

Producing assistants—Paul Whitney (domestic) and John Poulin (foreign).

Special assistants to PAD—Al Frame of Cities Service Oil Company, who heads up refining and technology; Carroll Fentress, who serves as liaison man between government and industry; George Gibson, who is in charge of the facilities department.

Consultants to PAD—Justin Wolf, slated to become general counsel for PAD; Elmer Batzell; Frank Watts of Humble Oil & Refining Company, director of materials division; Cecil Burrill of Standard Oil Company (N. J.), director of program division; William J. Littlejohn and Bernice Kirschling.

Aviation gasoline experts—Thomas Apjohn of Socony-Vacuum Oil Company; W. C. Huffman of Sun Oil Company; Bruce Dunbar of Shell Oil Company; Donald Heath of Socony-Vacuum; D. L. Neal of Phillips Petroleum Company; and Wayne Warren of Humble.

Transportation—John Boice of the Oil & Gas Division.

Financial advisers—George Parkhurst of Oronite Chemical Company; and George Hill of Cities Service.

Foreign—Terry Duce of Arabian-American Oil Company, who is informally assisting PAD.

Others who are expected to join PAD shortly are—Don Carroll, formerly of the Oil & Gas Division, who has been in Korea the last year, now back in Washington; Henry C. Foss of The California Company; Sol Brachman of Fort Worth; and Frank Grant of Consumers Cooperative Association.

Consultants to Administrator Chapman—J. R. Parten of Woodley Petroleum Corporation; and J. Howard Marshall, president of Ashland Oil & Refining Company.

Prices Jittery as U. S. Mobilization Hastened

Prices in the petroleum industry as well as in other important lines were abnormally unsettled in late December, as the federal government cautiously came to grips again with the familiar old problem of the inflationary effects of mobilization. Though holding off on mandatory general wage-price controls, the government was applying strong pressure toward holding prices down, including those in the petroleum industry.

Following its rollback and freeze of automobile prices at the December 1 level when auto makers declined to make such reductions voluntarily, the Economic Stabilization Agency was evidently contemplating similar freezing of crude and refined oil prices if unsuccessful in getting 40 contacted leading refiners voluntarily to hold prices at December 8 levels.

In general, this meant no rollback of prices but only a holdback on any contemplated increases. But in the case of California, the government asked that recent increases in prices of crude and residual fuel oil be rescinded, involving December 12 and October 23 postings that raised crudes 4 to 25 cents a barrel and residual 20 cents. Pennslyvania grade crude was raised 15 cents effective December 9, and no rollback was sought on this stripper production of limited volume and special demand, yielding needed lubricants, since the new prices had been announced December 8.

In California, Standard Oil Company of California on December 12 had increased heavy fuel oil 20 cents a barrel and crude oils from a maximum of 25 cents for 14 gravity down to 3 to 4 cents for gravities in the higher ranges. With this increase, Standard's postings for heavy oils were brought up to levels announced October 23 by Union Oil Company but exceeded by 3 to 4 cents Union's postings for lighter crudes. Union on December 12 met those light crude raises, making the schedules of the two companies generally the same. Standard's new postings followed by only a few days an announcement it was being forced to import a limited quantity of crude from Borneo because of inability in the past few

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Everything you need for safe, efficient drilling has been incorporated in the new Wheland B-85 Drawworks. Console Controls can be located in the safest place on the rig floor. Driller has finger-tip, precision control over all operations—plus full visibility.

Mechanical improvements in the field tested B-85 include 750 h.p. transmission with forged steel shafts and forged steel sprockets with cut, flame hardened teeth. All drive chains and sprockets have a generous factor of safety assuring long, trouble-free operation. Precision roller bearings are used throughout. Lubrication is by pressure feed.

For a 10,000' drawworks the B-85 breaks down into surprisingly compact, easily handled loads.

Get the complete story on this new rig through your nearby Jones & Laughlin supply store or write to Tulsa for free literature.

Wheland rotary equipment to match the B-85 drawworks:

HP-14000 7½ x 14, 350 h.p. Slush Pump
A-20, 20½ inch Table Top Rotary
J-2500, 250 ton Crown Block
K-2500, 250 ton Traveling Block
E-6600, 350,000 lb. Swivel.

FOR DRILLING TO 10,000 FEET with 4½" drill pipe

WHELAND
B-85 DRAWWORKS
WITH CONSOLE CONTROL

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months to buy sufficient light crude to supply its requirements for meeting military and civilian demands. When asked to rescind the recent increases, California refiners objected that the raises were essential to bring out more and higher-cost heavy crude supplies from marginal wells in order to meet urgent military and industrial needs.

The 15-cent raise in Pennsylvania grade, its sixth advance in 1950, put Bradford-Allegany crude at $4.25 per barrel. This compared with $3.54 at the beginning of 1950 but was well below the peak of $5 per barrel that prevailed in most of 1948. In announcing the increase, South Penn Oil Company stated it was "compelled and justified by the continuing refiners' demand for the increased supply." This crude is especially desirable for manufacture of lubricating oils, and lubricants have been in heavy demand for industrial and military use since outbreak of the Korean War.

Possibility of an impending general raise in crude prices was widely discussed in early December, and was spotlighted December 11, when K. S. Adams, president of Phillips Petroleum Company, asserted that such an increase was necessary to cover increases in costs of finding and producing oil and to provide effective incentive for assuring adequate oil supplies. "It is obvious that all costs of producing crude oil are rising rapidly," stated Adams, "while the selling price has remained unchanged during a prolonged inflationary period.

"I feel the major problem which confronts the oil industry now is to get its affairs in shape so that it will be able to supply from producing fields in this hemisphere, without any question of doubt, such military and domestic oil requirements as might arise in the event of a full scale war. This goal cannot be reached under prices presently being received for crude oil."

Mid-Continent crude prices generally have been unchanged since December, 1947, when the top price for Oklahoma-Kansas crude (40-gravity and above) was put at $2.65 per barrel. In September, 1948, Phillips initiated a further increase of 35 cents a barrel, and a few competitors met the raise, but other major purchasers declined to meet the increase, and within a few months the raises by Phillips and others were rescinded.

The crude market in the Mid-Continent lately has been firm but not so tight as to indicate that a general crude raise was inevitable or certain to be generally accepted if initiated. Crude prices traditionally are successfully cut or raised only when oversupply or scarcity forces substantial crude sales below or above generally prevailing schedules. Lately, refiners have not been complaining of inability to obtain sufficient crude, and premiums have not been paid except in special cases having no general market significance.

Likely to ward off shortages of crude in the Mid-Continent for several months at least is the present substantial reserve crude producing ability, which would permit authorization of considerably higher allowables in Texas and some increases in production quotas in Louisiana, Mississippi, New Mexico, Oklahoma, and Wyoming. At the levels of production at mid-December, there were indicated reserves of efficient producing ability in the amounts of about 825,000 barrels per day in Texas, 25,000 in Kansas, 75,000 in Louisiana, 17,000 in Mississippi, 22,000 in New Mexico, 33,000 in Oklahoma, and 7000 in Wyoming. These amounts totaled a little more than 1 million barrels per day. The figures are based on producing ability as estimated at mid-1950 by the Interstate Oil Compact Commission (WORLD OIL, September, 1950, page 41). However, all of this 1 million barrels a day of reserve producing ability cannot be accepted as readily available crude for meeting any possible requirements. Some of it is not available for lack of pipe line or other transportation. Some would not be of types, quality, or grades especially needed.

California also has an indicated 80,000 barrels per day or so of reserve producing ability, but it involves heavy crudes that refiners sought to bring into the market with higher prices recently posted but now criticized by the government. Current shortage of lighter crudes in California was emphasized by the December 12 price increases and the scheduling of imports from Borneo. T. S. Petersen, president of Standard Oil Company of California, recently pointed out that the West Coast oil industry, with only about 15 percent of total U. S. refinery runs, has been supplying more than 50 percent of the bulk military requirements for petroleum supplied by the country as a whole.

Prices of California heavy crudes were drastically reduced in 1949 because of oversupply. But the cuts were partially canceled by increases in 1950. Lighter crudes also were cut slightly at mid-1949, with Long Beach 27-27.9 gravity lowered from $2.45 to $2.37 per barrel. That grade on December 12, 1950, was raised 4 cents to $2.41, and similar changes have applied to other gravities above 27 at Long Beach and also in other California fields.

Industry Threatened by Shortage of Metal Goods

Threatening to retard drilling and development are growing shortages of other metals as well as steel and scarcity of pipe and other oil country materials, equipment, and machinery. Oil equipment manufacturers are competing for supplies of scarce metals among themselves and with manufacturers in all other durable goods lines, such as automobiles and household appliances.

The National Production Authority has ordered conservation of various metals by restricting manufacturers of civilian goods to varying percentages of average monthly consumption in a base period, the first six months of 1950.

Copper use is due to be reduced 15 percent below the base period in January and February, 1951, and 20 percent in March. Aluminum use for non-military purposes will be less than base period by 20 percent in January, 25 percent in February, and 35 percent for the remainder of 1951's first half. Non-military nickel use has been cut 35 percent as of January 1 and zinc was cut 20 percent. Cobalt for civilian use was cut 50 percent for December and will be cut even more sharply.

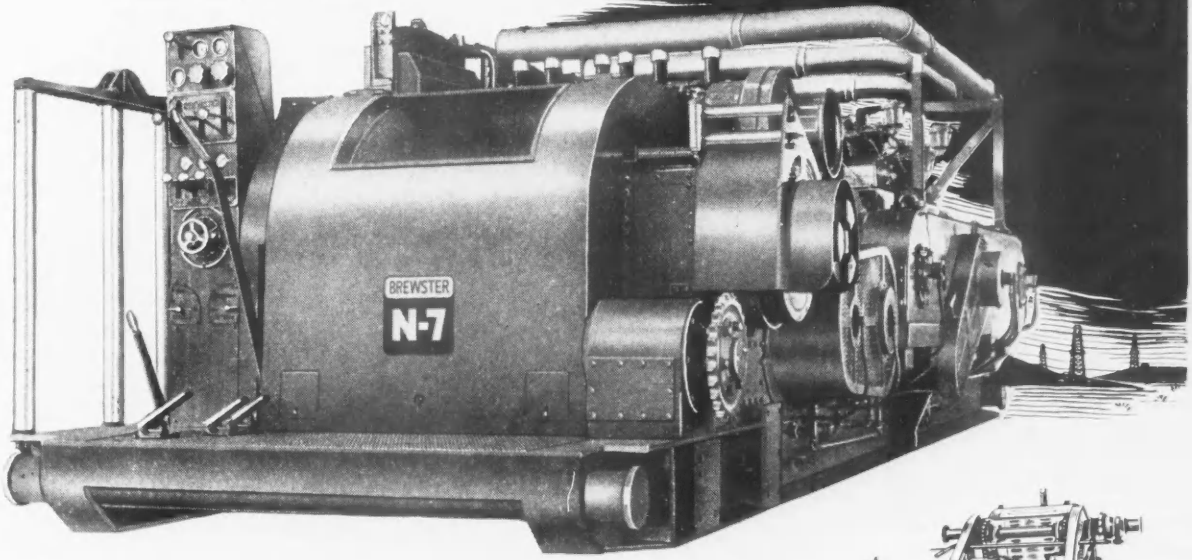
Since U. S. industrial activity is materially higher now than in the first half of 1950, the reductions in metal supplies from recent levels will be considerably greater than the percentages given above, based on early 1950 business.

Among oil country equipment manufacturers, difficulties in getting sufficient metals involve steel, steel alloys, copper, nickel, aluminum, zinc, tungsten, cobalt, and other scarce metals. Tank manufacturers point to large backlogs of orders that cannot be filled for lack of steel sheets. Makers of drilling bits indicate difficulty in securing nickel and tungsten for hardening them. Manufacturers of pumping equipment have encountered shortages of steel goods they require. Makers of boilers, engines, compressors, and other items likewise are concerned over scarcity of steel.

Eventually, shortages of such oil country items would seriously handicap petroleum drilling and development, even though the effect so far is not alarming. On the other hand, the industry already is seriously handi-

BREWSTER **N-7** DRAWWORKS

FOR DRILLING TO . . . 8,500′



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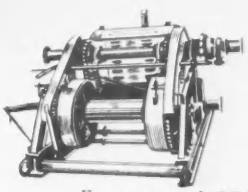
THERE'S 40 YEARS' EXPERIENCE built into the Brewster N-7 drawworks—the experience of contractors and drillers—the experience of Brewster engineers and craftsmen.



Forerunner of BREWSTER drawworks is the Early 1932 Model—heavy duty winch equipped with line shaft that could drill 3,000′

Soon after Spindletop—in 1910—Brewster began manufacturing drilling equipment right in the oil fields, to meet the needs of the men who were doing the drilling. That's the way Brewster engineers design equipment today—with one foot under the drawing board and one foot in the oil field.

THE E-FACTOR ON BREWSTER'S N-7

GIVES you that smooth flow of rugged power at just a touch of the simple controls.

PUTS the power to work where you need it—in a hurry. No wasted time—no wasted power.

MAKES hole fast—at a saving on every well.

MATCHED DRILLING EQUIPMENT

Model 6-S Swivel Oil Lubricated—220 tons.

Model 200 Block, four 36" Sheaves, 200 ton capacity.

Model RS-22 Rotary, 22" Table Opening, 265 ton Dead-load capacity.

N-7 DRAWWORKS

Most powerful in its class

600 h.p. transmission

4 forward speeds

1 reverse speed

8 line speeds

4 rotary speeds

Positive brakes

Accessible friction clutches

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capped by growing shortages of some other metal goods, especially casing, drill pipe, and other tubular goods. Although production of tubular goods has equaled current requirements, according to steel men, there has been unequal distribution, hoarding, and grey market dealing in pipe.

The industry hopes that with the aid of the Petroleum Administration for Defense, it can secure allocation of essential supplies of steel goods and also fair, equitable, and efficient distribution of the supplies among companies and operators. Bruce K. Brown, Deputy Petroleum Administrator for Defense, stated at mid-December that "Under presently existing mobilization conditions, I am quite hopeful that the well drilling program can be fully supported with material." He and Frank Watts, PAD's Materials Director, at that time announced PAD was working with the National Production Authority on a program under which 5 percent of oil country tubular goods production will be set aside in mills or warehouses for "emergency purposes," such as completion of wildcat producers or required offset wells. These needs can be filled without sending applications to Washington, but other purchases of tubular goods will require Washington approval of applications.

Industry Feels Pinch of Calls to Military Service

Mid-Continent oil companies are feeling the manpower pinch, particularly in the engineering categories, as more and more employes are called into military service. Not only laboratory technicians, but field engineers are being called back and operating companies manifestly are worried over the trend.

The situation has become sufficiently acute to attract the attention of the Oklahoma Society of Professional Engineers. Recently the Tulsa chapter of the organization, aware of the steady drain upon engineering manpower in this and other oil-producing areas, urged the federal government to act immediately on a plan for deferment of engineers and science students. Shortly after the Korean War started, the national society formulated a policy which embodies many improvements over previous proposals. If Washington can be made to act, oil companies feel that much needed relief will result. Unless something is done about taking young engineers from the field and laboratories, there will result a condition which in time may result in decreased production and certainly in wasteful practices.

Under the national engineering group plan there would be a manpower mobilization board for engineering and science-student deferments which would determine future needs in engineering and science. This plan differs from that previously submitted by advisory groups to General Hershey in that student deferments would be geared to the future defense needs of the country.

The earlier plan deals broadly with all fields of higher education, and no provision is made to tie in the flow of trained personnel with the national defense needs picture.

Under the proposed manpower mobilization board plan, the board would be composed of representatives of the government, engineering and science organizations and engineering and science schools. Under the plan the manpower mobilization board, after consultation with industry, government officials and educators, would forecast future needs for engineers and scientists, with estimates to be revised periodically. The forecasts would be predicted on the probable needs for several years in advance and would provide for a student body to supply these needs.

Accredited engineering and science schools would receive a proportionate allowance of the total number of deferred students.

Executives who have studied the proposed plan believe it is practical and will do much to plug the gap being created by withdrawal of engineering personnel.

Interest High in Nevada Activity Despite Failure

Interest in the oil possibilities of Nevada continues undampened by the news that the wildcat drilled jointly by Continental Oil Company and Standard Oil Company of California in White Pine County in northeastern Nevada was being abandoned. The project, Meridian Unit 1, was abandoned at 10,314 feet. According to some reports, a few shows of oil were encountered between 1200 and 1500 feet, and again at about 2170 feet.

The same companies are starting a second wildcat about 20 miles east of the previous well. The new project, Hayden Creek Unit 1, is about 25 miles southwest of the town of Ely and is reported to be on a new structure.

Diesel Fuel Oil Consumption Continues Steady Growth

Recent years have brought remarkable growth in use of diesel fuel oil in the U. S., and further increases in consumption are in prospect.

In recognition of the growing importance of this petroleum product, the U. S. Bureau of Mines has published its "Report of Investigations 4746," entitled "National Annual Diesel-Fuel Survey, 1950." The report contains information regarding the types and quality of diesel fuels currently being marketed, and will be of value to the petroleum industry, engine manufacturers, and consumers. The work on which the report was based was done under a cooperative agreement between the Bureau of Mines and the American Petroleum Institute.

Approximately 5 percent of the crude refined in the U. S. is processed for this purpose, according to the report. This figure represents approximately 20 percent of the total distillate-type fuel oils now being produced in the U. S.

A factor contributing greatly to the recent increase in consumption of diesel fuel has been the conversion from steam locomotives to diesel engines by various railroads. Other contributing factors are greater use of diesel engines in buses, trucks, tractors, water craft, and stationary power plants.

Continued dieselization of American railroads has been "the most significant trend in motive-power developments" during the past year, Robert M. Coultas, transportation divisions, General Electric Company, stated November 29 at the annual meeting of the American Society of Mechanical Engineers in New York. "Between the first of this year and September 1, the number of diesel-electric units ordered by domestic railroads has totaled 2,433," he said.

Outside the U. S., many countries are engaged in extensive railroad electrification, planning to use electric power made from both thermal stations and hydro sources. In those countries, coal and water power are considered more economical and dependable sources of power than petroleum for electric operation in changing over from steam, though the diesel-electric locomotive is being used in many cases as an adjunct to electric operation.

There are now four gas-turbine electric locomotives in actual running service throughout the world, said Coultas, including two placed in operation during the past year.

It walks right through with "Caterpillar" power

Working on the Inter-Provincial pipeline project in Saskatchewan, this "Caterpillar"-powered Cleveland ditcher made *5,300 FEET OF DITCH IN 12 HOURS* under varying soil conditions. In "all good" digging, actual timing has shown it making as much as 200 feet in 15 minutes.

"The 'Cat' Engine makes this a real outfit," said operator J. S. McPherson . . . which is typical of statements made by users of all types of "Caterpillar"-powered equipment. The leading manufacturers of ditching equipment are able to supply "Caterpillar" Diesels in their machines. Specify "Cat" Engines on your machinery orders and you write yourself an insurance policy for long and satisfactory machinery service. You can get this job-proved power with all types of oilfield machinery—pumps, drill rigs, compressors, excavators, generator sets, welders and all the others.

Today the importance of "Caterpillar" products, both for military use and for maintaining the national economy, is greatly increased. Talk over your machinery requirements with your "Caterpillar" dealer. He has ample parts stocks to keep your present equipment doing its job and will do his utmost to make prompt delivery of new machines.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

LOOK UNDER THE HIDE

Connecting rods for "Caterpillar" Diesels are made of medium carbon steel, drop forged and heat treated. Of "H" section design, they are rifle drilled to provide oil passage to the piston pin, and to oil-cool the piston. Connecting rods are balanced to close limits. Crankpin bearings are solid aluminum alloy, precision type. Piston-pin bushings are bronze and are precision bored. Look under the hide for built-in quality.

CATERPILLAR *Oilfield Engines*

Completions

Top 1948 Record

IN THE first 11 months of 1950 there were 40,354 wells completed—more than had ever been drilled in any previous whole year. The 11-month total bettered the previous annual record of 40,010 drilled in the industry's peak year of 1948. Those wells, compared with the 36,231 drilled in the first 11 months of 1949, showed a gain of 4123 wells or 11.4 percent.

There was an even greater gain in the amount of footage drilled than in the number of wells completed. The all-time high for footage was reached in 1949 instead of 1948, when the well-record was set. In the first 11 months of 1950, there were 146,455,612 feet drilled, and that amount represented an increase of 14.7 percent over the 127,686,707 recorded in the first 11 months of 1949. In 1950 each new well completed averaged 3678 feet in depth, while a year before each test was carried to 3558 feet, or 120 feet less, on the average.

If December's drilling resulted in no more wells and footage than did November's, which was under the average for the previous six months, the year's totals would be about 44,100 wells completed and 160,600,000 feet. That well completion total would include some old wells that were deepened, but new wells would total more than 43,000; and never before have new tests exceeded 40,000.

A number of states contributed to the increased drilling during 1950, but the greatest share of the hike was attributable to Texas. In that state, wells drilled in the first 11 months exceeded those completed in the comparable period of 1949 by 2757 wells or 21.3 percent.

Well Completions in the United States during November, 1950, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Alegany fields of Pennsylvania and New York from the *"Producers Monthly."*)

	MONTHLY COMPLETIONS, NOVEMBER, 1950													CUMULATIVE TOTALS January-November					Rigs in Operation (Drilling, Rigging-Up and Shut Down)		
	NEW WELLS									TOTAL COMPLETIONS											
STATE or DISTRICT	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	Nov., 1950	Oct., 1950	Nov., 1949	Footage Nov., 1950	Wells 1950	Wells 1949	Percent Diff.	Footage 1950	Footage 1949	Nov. 30, 1950	Oct. 31 1950	Nov. 30, 1949
Alabama	2			2				4		4	6	1	19,093	41	15	+173.3	176,557	72,011	8	5	4
Arizona				3				3		3	1		10,745	8	5	+ 60.0	32,108	15,603	3	4	4
Arkansas	26			12				38		38	25	31	126,373	358	305	+ 17.4	1,187,562	1,213,462	37	36	26
California	146	2	7	40				195	9	204	136	212	787,205	1,747	2,335	— 25.2	7,039,491	9,333,352	192	232	227
Colorado	4		1	4				9		9	12	5	47,447	76	62	+ 22.6	313,325	276,860	25	18	17
Florida												1		11	17	— 35.3	69,518	114,224	1	1	4
Georgia														3	4	— 25.0	13,270	12,437			1
Idaho				1				1		1	1		2,230	5			16,367		1	1	
Illinois	90		5	152				247		247	272	242	626,263	2,641	2,422	+ 9.0	5,807,976	5,717,493	250	255	255
Indiana	35		2	51				88		88	132	104	156,945	1,420	1,134	+ 25.2	2,424,119	2,089,949	194	193	143
Kansas	138		25	121			11	295	1	296	445	337	982,325	3,598	2,840	+ 26.7	11,594,013	9,368,702	333	330	303
Kentucky	47		19	42				108	2	110	119	102	207,744	1,150	1,021	+ 12.6	2,130,771	1,771,435	110	108	93
Louisiana	99	6	18	72				195	3	198	226	215	1,134,354	2,262	2,098	+ 7.8	13,586,483	11,274,471	252	229	241
North Louisiana	60	3	10	38				111	1	112	119	141	416,795	1,208	1,270	— 4.9	4,249,177	4,096,412	88	76	82
South Louisiana	39	3	8	34				84	2	86	107	74	717,559	1,054	828	+ 27.3	9,337,306	7,178,059	164	153	159
Maryland											2			4	1	+300.0	16,636	4,910	5		
Michigan	30		7	47				84	1	85	90	81	249,623	785	851	— 7.8	1,915,945	1,947,963	116	138	140
Mississippi	4			14				18		18	26	18	128,589	302	311	— 2.9	2,170,539	2,273,078	27	28	38
Missouri			1					1		1	3	4	982	27	26	+ 3.8	21,482	12,249	6	6	10
Montana	17		1	10				28		28	30	20	67,276	255	244	+ 4.5	633,647	601,190	37	41	43
Nebraska				8				8		8	16	3	31,094	98	14	+600.0	410,451	59,947	10	13	6
Nevada				2				2		2			14,439	2			14,439			1	
New Mexico	31		10	9				50	1	51	60	44	218,221	572	480	+ 19.2	2,535,034	2,098,314	87	87	103
New York	25				18			43		43	44	97	61,155	687	837	— 17.9	1,006,753	1,195,236	92	100	95
North Carolina															1	—100.0		1,280			
North Dakota												1			4	—100.0		18,030	2	2	1
Ohio	30		19	34				83	2	85	104	98	166,802	924	968	— 4.5	1,897,864	2,055,171	156	161	169
Oklahoma	254	2	22	158	4	8	2	450	18	468	548	480	1,589,449	5,004	4,066	+ 23.1	17,615,901	14,389,039	671	692	545
Oregon															1	—100.0		6,480	1	1	
Pennsylvania	50		26	12	55	8		151	2	153	157	169	264,774	1,527	1,945	— 21.5	2,773,695	3,658,545	250	255	248
South Dakota				1				1		1			2,475	6	6		19,397	12,803		1	2
Tennessee														3	43	— 93.0	3,993	44,462	7	8	7
Texas	959	16	61	465	4		1	1,506	43	1,549	1,604	1,268	6,883,787	15,672	12,915	+ 21.3	66,702,359	53,376,810	1,469	1,481	1,384
Dist. 1 S. Central	28	1	3	35				67	2	69	51	50	265,276	486	512	— 5.1	1,441,899	1,554,369	34	38	39
Dist. 2 Middle Gulf	28	2	4	25				59	2	61	87	53	353,430	647	598	+ 8.2	3,725,614	3,499,414	50	61	51
Dist. 3 Upper Gulf	65	5	7	42				119	2	121	123	149	740,066	1,440	1,273	+ 13.1	8,536,904	7,603,825	144	150	136
Dist. 4 L. Gulf-S.W.	98	6	10	58				172	1	173	138	114	846,518	1,553	1,231	+ 26.2	7,500,421	6,114,572	104	118	100
Dist. 5 E. Central	5	1	5	12				23		23	17	11	101,026	188	179	+ 5.0	841,196	837,474	22	19	24
Dist. 6 Northeast	65		6	7				78		78	90	63	368,607	635	815	— 22.1	3,050,426	3,604,087	37	44	43
Dist. 7-B N. Central	97		1	93			1	192	5	197	201	173	529,274	1,901	1,759	+ 8.1	5,214,609	5,187,045	147	135	175
Dist. 7-C W. Central	50		2	35				87	7	94	116	66	334,321	900	455	+ 97.8	3,562,509	2,012,630	105	82	86
Dist. 8 West	345	1		58				404	20	424	365	272	2,399,415	3,961	2,670	+ 48.4	21,338,283	13,090,801	484	547	459
Dist. 9 North	134		1	87	4			226	4	230	265	224	701,212	2,975	2,411	+ 23.4	8,400,529	6,620,604	239	196	173
Dist. 10 Panhandle	44		22	13				79		79	151	93	244,642	986	1,012	— 2.6	3,089,969	3,261,989	103	91	98
Utah				2				2		2		2	13,282	21	53	— 60.4	80,853	268,294	10	12	12
Virginia												1			15	—100.0		66,660	1	1	1
Washington														2	2		16,032	4,910			1
West Virginia	8		26	11				45	2	47	56	72	133,272	595	630	— 5.6	1,534,784	1,696,590	210	245	256
Wyoming	20	1		26				47		47	60	57	228,337	548	560	— 2.1	2,694,248	2,634,747	86	91	106
Total U. S.	2,015	27	250	1,299	81	16	14	3,702	84	3,786	4,175	3,665	14,154,221	40,354	36,231	+ 11.4	146,455,612	127,686,707	4,649	4,773	4,485

What's Ahead in '51...?

"Industry Mobilization to Aid Defense,"

Reply Presidents of Oil Companies

WHAT is the oil industry's major problem in 1951? Defense of the U. S., say the presidents of some of the nation's largest producing oil companies.

On the threshold of an ominous new year, WORLD OIL invited the industry leaders' opinions on "our new problems and new challenges. What are they and how shall we meet them?" the presidents were asked. "We on WORLD OIL believe that we can do the thinking men of the oil industry no greater service than to usher in the New Year by suggesting what these problems—and their solutions—will be."

Maximum effective aid to U. S. defense hinges on maximum production, the presidents reminded, and warned that this cannot be accomplished without:

- Ample steel.
- Minimum government regulations.
- Relief from the threat of anti-trust suits.
- Fair prices.
- Reasonable taxes.

The executives' statements in full:

P. C. Spencer

Sinclair Oil Corporation

We probably will have not one major problem, but several. However, to answer your question as you phrase it, I can only reply that the major problem is to supply military and civilian requirements in the quantity needed and at the time and place necessary for defense and for the needs of our people and of industry.

Important segments of this problem—but not the only ones—are: Sufficient aviation gasoline and a supply of steel sufficient to drill the required number of wells, to extend our transportation facilities, and for refinery additions. It is my belief that given a fair opportunity the industry will solve any and all problems that may confront it.

P. C. Spencer

K. S. Adams

Phillips Petroleum Company

In looking forward to 1951, one problem appears more serious than all others. How can the oil industry most effectively utilize all its abilities to be of greatest value in the present international situation? Oil is a fundamental and indispensable factor in the defense of this nation. Therefore, the oil industry can be regarded as fully discharging its responsibilities only if it conceives and effectively carries out a program which will make its maximum potentialities available when and if called upon.

K. S. Adams

This country has come to rely more and more on petroleum produced in foreign countries. Some of this oil, like that in the Middle East, cannot be depended upon in event of any major international incident in that area. Naturally, all of us fervently hope that no military occasion will arise to call for a flood of oil as great or perhaps much greater than that which our industry had to produce in World War II. However, we cannot safely base our plans on hopes alone. We must face the stark realities and be prepared to supply all military and civilian petroleum products from this hemisphere and in whatever quantities any occasion might demand.

It is becoming increasingly difficult for the oil industry to operate in the face of many increases in the costs of finding, developing, and producing crude oil and natural gas. Recent wage hikes and increases in the cost of steel and most other materials are increasingly serious barriers to the building up of adequate reserves. Steel is most difficult to obtain. The supply of manpower is gradually decreasing.

unbelievable number of man-hours of key personnel, which could be better used at this time.

In the principal producing areas of the U. S. the price received for crude oil has remained constant, with minor exceptions, for more than three years. This has been a long period of successively rising operating costs. Every increase in costs has diminished the incentive and ability to find, develop, and produce new crude oil reserves. The present static crude oil selling price could well become one of the greatest stumbling blocks in our nation's military preparedness program. It is absolutely necessary that we immediately start to develop in North and South America reserves of oil and gas adequate to supply ourselves and our potential allies.

☆

L. F. McCollum

Continental Oil Company

The petroleum industry will be confronted with two major problems in 1951—the unsettled international situation and the threat of further governmental interference which is likely to occur as a result of the international tension. The attempts toward industry regulation could hamper the very aims of the government to establish an adequate supply of petroleum products for civilian and defense needs.

L. F. McCollum

It would be particularly unfortunate if under the guise of national emergency and the need for additional tax revenues we should witness renewed attacks on some of the existing incentives which have been instrumental in developing this country's crude oil reserves and production, such as the provisions of the statutory depletion tax laws.

As a solution to these problems, I can propose only that the petroleum industry continue to expand its productive capacity so as to meet sudden defense needs and that the case for free enterprise and retention of the incentives necessary for the industry to do the job be presented to the public and to the government at every opportunity.

H. S. M. Burns

Shell Oil Company

"Once more into the breach," will be the oil industry's watchword for 1951. Once more will it accomplish the impossible. More crude oil will be found, produced, refined, and distributed — while working against time and material shortages.

H. S. M. Burns

The demand for petroleum products to sustain a military force such as is now contemplated will exceed normal peacetime requirements. At the same time the wheels of industry must be kept turning so that the productive capacity which is our country's most formidable weapon may be developed to the fullest.

Steel is needed for guns and tanks so we shall not get all the steel we'd like to have for our oil wells, pipe lines and refineries. Allocations will be fair but far from ample. Nevertheless, I am confident that the oil men of America will do the job. Shortage of material will be made up for by the maximum exercise of that ingenuity which has brought the industry to the proud position it holds today.

☆

T. S. Petersen

Standard Oil Company of California

It seems to me that there is no one problem facing the West Coast petroleum industry as it enters 1951 that can be singled out as being *the* most important. However, one of the foremost difficulties we face during the coming year is the matter of steel availability. Already a number of companies are experiencing severe difficulty in obtaining their requirements to maintain recent levels of drilling operations. This shortage has emerged in the initial stages of the country's expanding military preparedness, and foreign military aid programs, both of which will draw increasingly upon the nation's steel production which is currently at higher than rated capacity level. If the petroleum industry is to meet anticipated demands for crude, while continuing to develop reserves, oil field tubular steel products will be needed in volume in excess of that used in 1950. Procurement of these needs probably will be a continuing and difficult problem in 1951.

T. S. Petersen

Although over-all supply and demand outlook is generally favorable, it is anticipated that a second major problem for the industry will be the supplying of all high octane aviation gasoline demand, which has been expanded sharply in recent months by increased requirements of the armed forces. Adding to refinery capacity necessary to increase output of such high-test fuel involves construction of heavy and intricate facilities, and requires time, as well as substantial capital outlays.

☆

B. Brewster Jennings

Socony-Vacuum Oil Company, Inc.

In my opinion the major problem likely to confront the oil industry in 1951 is that of meeting augmented national defense and European rearmament needs for petroleum products, with minimum impairment of our civilian economy.

B. Brewster Jennings

Even with the limited scale of operations in Korea during most of the last half of 1950, the oil industry has been hard put to supply the amounts of military grade aviation gasoline required by the Services. With the increased defense program contemplated in the coming year, it seems probable that these demands will be substantially increased. To supply the additional aviation gasoline will require maximum production of alkylate and other high octane materials, as well as careful selection and interchange among refineries of the best gasoline base stocks.

I believe that through the establishment of the Petroleum Administration for Defense, suitable means have been created for accomplishing this essential purpose, and that our country's needs for defense will be met with little, if any, adverse effect on the civilian economy.

Hardships Mount as *Steel Shortage* Worsens

An Interview With

RUSSELL B. BROWN

General Counsel, IPAA

RUSSELL B. BROWN

Editor's Note: *Russell Brown's opinions on industry problems are soundly rooted in a background of 20 years with the Independent Petroleum Association of America. Born in Morgan County, Kentucky, he moved to Ardmore in the Indian Territory in 1896, attended the University of Chicago Law School, and was admitted to the Oklahoma State Bar in 1913. He practiced law in Ardmore until 1930; then was named executive manager and later general counsel of IPAA. He has been a vigilant and articulate guardian of the independents' interests.*

Q. *How serious right now is the steel shortage for the producing sector of the oil industry?*

A. The degree of seriousness of the situation is demonstrated by the unusual and inflationary practices that producers are forced to rely upon in order to obtain pipe.

The hardships being suffered are mounting as time goes on. Some operators have continued in business so far by living a day-to-day existence, being forced to borrow pipe for immediate needs, and then having to borrow again in order to repay the friend who had helped them out. Others are faced with forced offsets with no pipe in sight. An increasing number of operators report that they are unable to place any orders for the coming months.

Some operators have carried on drilling so far at the expense of using up their inventories of pipe. This means that the effects of the present shortage have, to some extent, been alleviated by absorption of inventories. Now that inventories have been drained, the effects of the shortage will become more evident as this cushion disappears.

Q. *Has the steel shortage as yet affected drilling operations?*

A. Yes. While the industry as a whole has not yet been forced to curtail drilling, individual operators have been unable to carry out their particular programs. The over-all drilling program of the industry has been accomplished at greatly added cost, particularly to the smaller operators, and it has involved a great loss of time and energy in finding a supply of steel.

There are some who say that the record number of wells drilled this year is evidence that the steel supply has been adequate. To me that is no sufficient answer. I am convinced that many more would have been drilled if the pipe had been available.

During 1950 the industry will drill close to 43,000 wells. This is an all-time record, but it must be remembered that year after year throughout the history of the industry consumer demands for oil have increased. This means that each year more wells must be drilled than previously to maintain sufficient reserves. For this reason it is normal to drill more wells in 1950 than in any previous year.

The present international situation places an added burden on the industry and makes it desirable to drill all that the domestic industry is capable of drilling. We do know from the experience of individual operators who have had to curtail drilling programs that more wells would have been drilled in 1950 had the steel been available. We likewise know that this additional drilling that has been delayed because of the steel shortage would have provided a wider margin of producible reserves to meet our normal demand increases and such emergencies as seem to face us.

Q. *What is the present extent of maldistribution of steel as far as it affects oil and gas producers?*

A. The maldistribution of the supply of pipe is perhaps the most serious aspect of the steel problem. In any short supply situation the smaller elements of the industry suffer greater hardships than the larger. This is brought about by the fact that the larger companies have long established customer relationships with the steel companies and the supply houses.

■ CONTINUED ON PAGE 54

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in the Oil and Gas Industry

By JAMES R. FELT
Billings, Mont.

TAX problems connected with oil and gas interests are technical and complicated, and by their very nature should receive constant study, not alone at income tax paying time, but throughout the year. The operator who keeps constantly abreast with this phase of his business will benefit in time and money saved when the annual critical tax computing period rolls around.

The important problem affecting probably three-fourths of all litigated cases that have come up in this field is a determination of whether or not the taxpayer holds "an economic interest in the oil and gas in place," as that term is understood in federal income tax law. Generally speaking, an economic interest in oil and gas in place is held by a person who has invested capital in a piece of property and who looks to production for the sole chance of any financial gain. The difficult part, of course, is applying that to specific situations. There is nothing in the statute that defines it or no ruling that gives a real definition, but we know that all the various types of royalty interests do constitute an economic interest in the oil and gas in place. The same is true of one who retains a right to share in the net profits of production. That was determined when the Supreme Court settled the question in the Kirby Petroleum Company case.

Another type of property interest that does constitute an economic interest in oil and gas in place is the right to an oil payment. The holder of an oil payment right has the right to recover or to receive out of production, if, as and when there is production, a fixed amount of money or oil in kind—for example, the right to receive $10,000 out of production. The proceeds he will receive are limited in amount. The royalty holder, of course, does not know how much he is going to get, and neither does the holder of a working interest, nor the holder of the right to share in the net profits of production.

Working interests have another feature to them, in the nature of a subdivision. An interest called a "carried interest" arises when two or more persons own undivided shares of the working interest and one of them has the capital to develop the property while the other one does not have the necessary capital. The operator with the capital will enter into a contract with the carried party and agree to develop the property and pay all expenses. Now ordinarily, of course, the holders of the working interest are supposed to bear all of the development costs jointly, but where one cannot do it, this type contract is made. The operator who advanced the capital will recoup his costs out of the oil produced and until he has recovered his cost the carried party does not receive any part of the proceeds. Sometimes those agreements are drafted in such a manner that they will continue for the lifetime of the lease, and then it is called an "unlimited carried interest." Other times they are to continue only for the purpose of developing one or two wells, and that is considered a "limited carried interest." However, there still is conflict between the Bureau of Internal Revenue and the courts. The bureau maintains that the holder of an unlimited carried interest does not have an economic interest in the oil and gas in place, although it will allow the holder of a limited carried interest to be considered as the holder of an economic interest in the oil and gas in place. The courts, however, have held that any carried party does have an economic interest in the oil and gas in place.

These various property rights have been discussed because that determines the tax consequences of so many transactions in the oil and gas industry. Let us now discuss specifically the problems in connection with production payments. Assume a producing well where the operator holds the working interest, collects the oil and sells it. Out of the proceeds he makes payments to his predecessors in title. There may be any number, including the landowner, perhaps an intervening party who took the original lease and then assigned it, and there may be more than one person intervening there—perhaps the holder of an oil payment right. But he makes the necessary payments to his predecessors in title he pays his expenses of operating the field and he pays an income tax. He has a difficult question in determining that income tax, largely because the depletion deduction is so hard to calculate. In the first place, he has two alternative ways to compute his depletion deduction. One is called depletion

OIL AND GAS operators must devote constant study to the complicated and technical problems involved in connection with taxes, in order to save time and money when the annual tax computing period occurs. Among the tax problems here discussed are those involving the percentage depletion allowance, royalty payments, intangible drilling and development costs, bonus payments, investment payments, and handling costs for income tax purposes.

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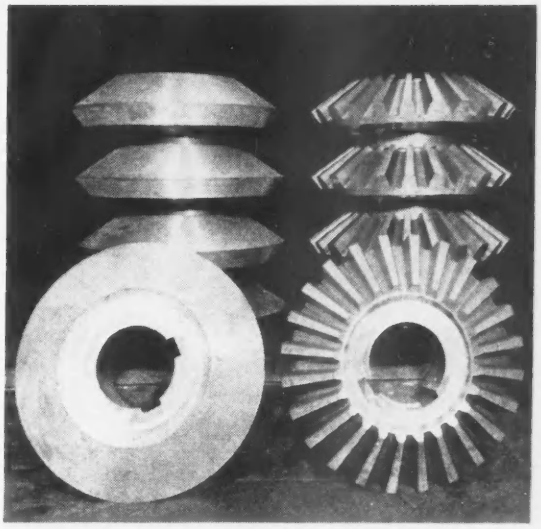

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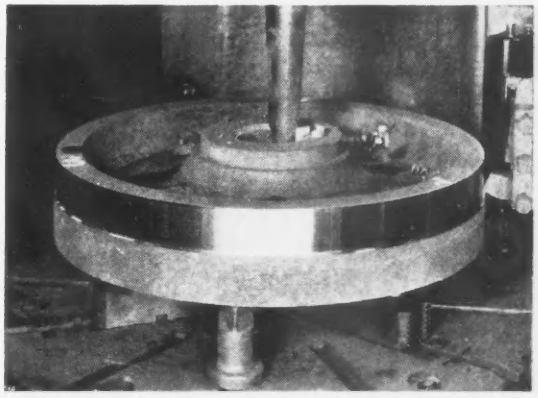

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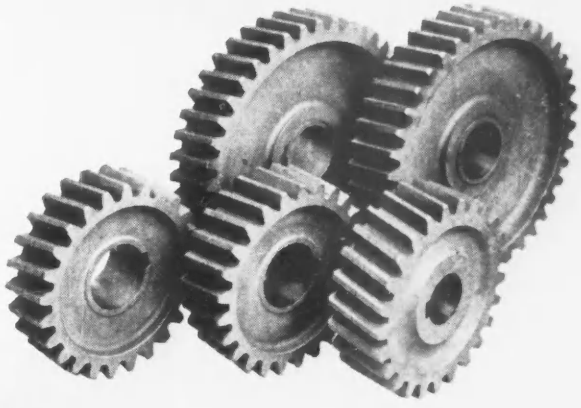

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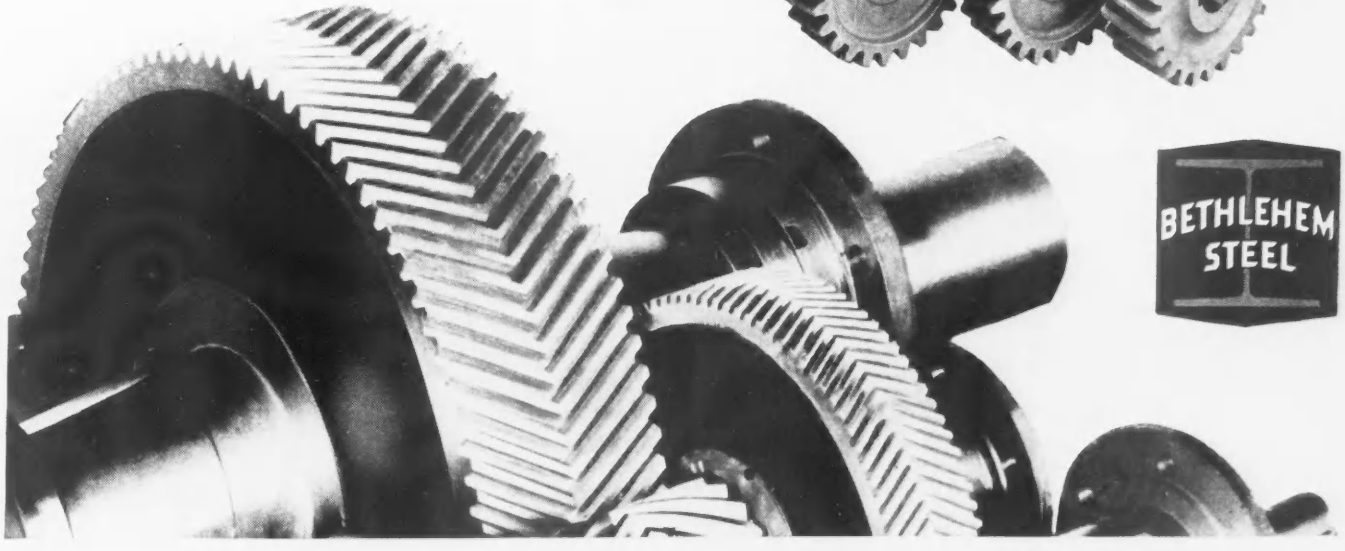

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and the other is called percentage depletion. Cost depletion is very technical and is based upon engineering estimates, but it is in general the same type of a deduction as depreciation deduction. We take the total cost of the property to the holder of the interest and spread that cost throughout the number of units, e.g., barrels of oil, that are in that property; and as the oil is drawn out the producer is allowed to claim depletion ratably and eventually it is expected he will recover his entire cost, tax free, through that depletion deduction.

The other method of computing depletion, the percentage method, is an arithmetical computation allowed by Congress for convenience. The statute reads that depletion will be 27½ percent of the gross income from the property but in no event more than 50 percent of the net income of the property. This immediately poses three questions: First, it is necessary to ascertain what constitutes the property and here again there is a conflict between the bureau and the courts. The Tax Court has laid down as its test of what constitutes a specific property, a rule which declares that any property operated as an economic unit constitutes a separate property. The bureau, however, believes that an operator may have more than one property within the same economic unit. If an operator has acquired various interests from different individuals or at different times, he may have more than one property and the bureau requires him to compute his depletion deduction separately on each of those interests.

The next problem would be to determine what constitutes the gross income from the property. Gross income is based upon the sale price of the crude in the field. Assume that a particular well has had gross proceeds of $1 million from the property through production. The producer does not take 27½ percent of $1 million to determine his depletion deduction in very many cases. Probably a landowner had reserved a 12½ percent royalty; perhaps another individual may have reserved an oil payment right of $100,000. If that landowner has not received any advance royalty in the year that $1 million is produced he will be paid $125,000 under his royalty interest and the holder of the oil payment right will be paid 100,000 for his oil payment right. There would be $225,000 which would be deducted in determining the "gross income from the property" so that the producer would take 27½ percent of $775,000. That would be his percentage depletion except that he would then have to determine his net income from the property to make sure that that depletion deduct' 1 did not exceed 50 percent of the net income.

Consider what effect advance royalties have in this connection. In case there had been an advance royalty paid to the landowner when he executed his lease and reserved his royalty, the producer who paid the advance royalty has an option as to when he is going to deduct that advance royalty. He could deduct it in the year he made the payment, whether there was any production that year or not, or he can wait until the year there is actual production and deduct it at that time. It would make a difference to him in measuring his depletion deduction because if he deducted it in the year before there was production he would not be allowed to deduct it the second year. So his gross income in that case would be $875,000 and his depletion would be 27½ percent of that amount. Incidentally, the election between cost depletion or pecentage depletion is not a binding election for subsequent years. The operator has the choice every year, but the election as to how he is going to treat his advance royalties is binding. The first year that he has that problem he must make the election. If he doesn't do anything about it when he files his income tax return, it is assumed that he is not deducting them in the current year and is going to wait until the year that there is production.

Measuring Net Income

When it comes to measuring net income, the operating expenses that the producer has incurred during the year are deducted and again he has an election. This election comes up in connection with intangible drilling and development costs and the producer, or whoever pays or incurs intangible drilling and development costs, is allowed either to deduct them as a current expense or capitalize them and recover that cost in future years through depletion and depreciation deductions. It is a rather common question in the income tax field to determine whether or not a particular cost should be charged to expense or capitalized, and it was felt that this problem was especially acute in the oil and gas industry. Therefore, we were given this option and we can take these costs either way, but once this option has been exercised, it is binding for subsequent years.

It is difficult to say what constitutes intangible drilling and development costs. They are defined in the Regulations in quite a few words, but when a specific problem presents itself the operator generally has trouble in defining their meaning. Generally speaking, they include the costs of clearing land, draining it, road building, and the labor that goes into the erection of buildings necessary for drilling. It includes the costs of drilling, cleaning and shooting of wells, and anything where, after the expense has been paid, the operator has nothing tangible to show for the money spent. The rule in regard to intangible drilling and development costs was changed a few years ago and it is now possible to have a turnkey contract whereby the operator is allowed to deduct the entire cost paid to a drilling contractor and the whole price then is considered intangible drilling and development cost. It is not so hard in that case but where the operator is going to do his own drilling or when it is a question of the drilling contractor himself deciding what he's going to deduct, he has to keep accurate records, break down his expenses, and decide which are intangible drilling and development costs.

In case the operator elects to capitalize his intangible drilling and development costs and drills a dry hole, he is then given an additional option to expense the cost of that dry hole.

Consider the tax consequences to that landowner who, it was earlier assumed, received $125,000 royalty income. Since he is a holder of a royalty interest he has an economic interest in the oil and gas in place. Therefore, he must treat that $125,000 as ordinary income. He did not make a sale when he gave the lease and received a royalty. He has a reversionary right to all the oil and gas in place and he has a right to share in proceeds of production so that although we treat the purchaser as having purchased an asset, the seller has not sold anything. The $125,000, therefore, would be his gross income from the property and he would be allowed to claim depletion at 27½ percent of that amount.

The holder of an oil payment right also has retained an economic interest in the oil and gas in place and he is allowed to claim the depletion deduction on the $100,000 that he receives but he must treat that $100,000 as ordinary income when he receives it. Those oil payment rights are a little trickly because for some purposes they constitute an economic interest in oil and gas in place while for other purposes they do not cast their influence as an economic interest upon certain other types of payments. This does not refer to bonus payments which will be discussed later. It should be added that in case the holder of the oil payment right had additional security for his $100,000. For instance, if he had reserved an interest in the fee of the lands to guarantee that he would receive his $100,000, or if he had received a personal guarantee of the person to whom he transferred that the $100,000 would be paid, then he does not

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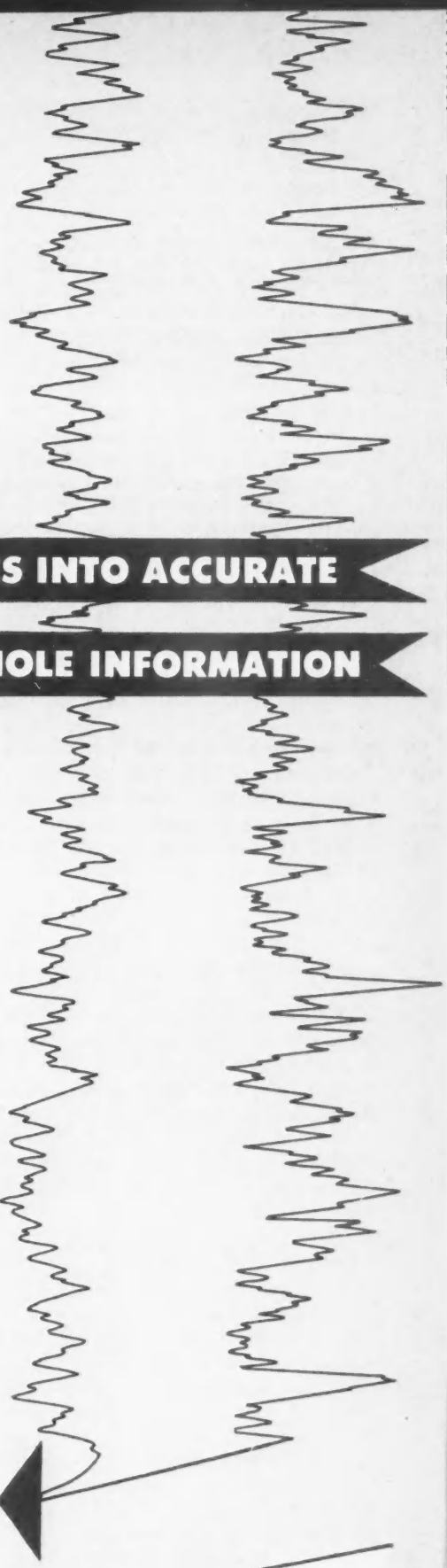

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have an economic interest in the oil and gas in place. He has then made a sale and the payments which he would receive would be the sale price of an asset so that he would not have ordinary income. He would have capital gain.

If there were any other intermediary parties holding, for instance, an over-riding royalty or a right to share in the net profits of production, the production payments which they receive would be ordinary income to them and they would be able to claim the depletion deduction.

There are problems that arise in connection with bonus payments generally. Consider first the problem in respect to the payer of a bonus. A bonus is occasionally paid, particularly where there is a proven field, to a person who grants a lease or assigns a lease. Such a payment does not apply against his right to share in future productions. The payer is not allowed to deduct any bonus when he pays. It might be said that he gets no tax benefit at all when he pays a bonus, except in one situation. If he is using the cost depletion method it increases the cost to him of his property and his depletion deduction would increase. But if he is using percentage depletion he gets no tax benefit at all from the bonus he has paid. How it is handled by the payee depends upon whether or not he has retained an economic interest in the oil and gas in place when he made the transfer. If he has retained that economic interest, the payment to him of a bonus will be ordinary income. It will be treated then just as though it were an advance royalty and he would be allowed to claim the depletion deduction. In case a person receives a bonus and claims depletion on it and then there is never any production, he must add back the amount he deducted for depletion and it becomes income to him in the year the lease is terminated or abandoned.

The payee who receives a bonus but does not retain an economic interest is allowed to claim capital gain treatment whereby only 50 percent of the gain is taken into account instead of 100 percent, and even that 50 percent is given, in various ways, preferential tax treatment. In order to qualify for the capital gain treatment the transferer of a property interest must either sell all of his interest for cash or retain only a right to an oil payment. It doesn't matter whether that oil payment is secured. In either case he would be allowed capital gain treatment on a bonus, according to the majority rule. There is some conflict on that point but the majority rule seems to be developing very strongly now and it is safe to say that he will get a capital gain on that bonus that he receives. However, if he retained a royalty or an over-riding royalty or a right to share in the net profits of production, he would not be allowed the capital gain treatment. His bonus would be ordinary income.

There are the problems which arise in connection with investment payments. Quite commonly an operator makes an investment in a property by paying a lump sum to the holder of a working interest or to the holder of a royalty interest. We must consider that payment both as it affects the payer and the payee. As to the payer, the payment which he makes it not deductible; it is the purchase price of an asset just as though he'd bought a car or a house. As to the payee, he will receive, let us say, $10,000 for a participating interest in a well. Whether or not that is taxable income to him depends upon whether or not he is required to use the $10,000 to develop the property. If the money is pledged for development purposes it is not income to him, but if he is not restricted as to the use which he'll make of that $10,000, it is taxable income and he would determine the amount of his gain by allocating a portion of his cost of the interest which he held before he made this deal, to the part which he has sold. His gain will be the difference between that allocated cost and the amount he received, but he could claim capital gain treatment on that. He has made a sale of a property interest which he is allowed to separate from his larger property interest. To claim the capital gain treatment it is also necessary that he have held the property interest for six months and that he not be a dealer in that type of property interest. In other words, if that is the way he makes his living he can't claim a capital gain; it must be something which he has held for investment and has sold; something which he is not using in his ordinary trade or business.

Now consider the payments received when an oil payment right is sold. The holder of an oil payment right not uncommonly sells that right to a refinery or any person who would be in the market for it. If he sells it as a short term oil payment right he is merely anticipating his future income and he must treat the payment he receives as ordinary income and claim his depletion. However, a fairly common device to save some income taxes is to sell a long term oil payment right and the General Council's Memorandum on that point has stated that a long term oil payment right which is sold will cause a capital gain. The memorandum is vague as to what constitutes a long term right but one which could be received in less than four years could hardly qualify.

Following are a few special problems that are not so wrapped up around this problem of whether or not the property right constitutes an economic interest in oil and gas in place. It isn't uncommon for an operator holding the working interest to grant production rights to a contractor for drilling a well. Such an agreement does not have tax consequences. The courts are reasonable here and do not anticipate profits in this oil and gas industry, although in other businesses we might find them levying a tax upon that type of transaction. The producer might have sold his production rights for cash and then used the cash to pay a contractor to drill a well. He would have reached the same result but his tax consequences would be different because when he sold his production rights he would have received cash, and he would have had to pay a tax upon that cash unless it is pledged particularly for a specific well or a specific purpose.

As regards the driller, there is a different problem as to how he is going to compute his tax consequences when he drills a well and receives production rights as his consideration. He is not taxable upon those production rights when they are received merely because he has drilled a well. That is a corollary to the principle that the producer is not going to be taxed upon the value of the well when he receives it in exchange for the production rights. The courts postpone any tax to that drilling contractor until he actually receives some of the production proceeds. However, that drilling contractor cannot deduct

About the Author

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all expenses which he incurred when he drilled that well. He must make an allocation of his costs and he cannot deduct the portion applicable to his share of the production rights. That portion is the cost to him of those production rights. The rest of his expenses he can deduct. If part of his consideration is cash and part of it is the receipt of production rights, he must deduct the portion of his drilling costs applicable to the cash he receives.

A rather common question is when to claim a loss deduction when a royalty interest or any interest in a property has become worthless. It is a difficult question of fact. That is why there are so many cases on it; each case depends upon its particular facts. There are a few general principles, however. It is not necessary to prove that any further production is impossible. However, it must be established that the royalty right has no further sale value whatsoever. Partial worthlessness or a decrease in the sale value would be insufficient evidence; it must have no sale value whatsoever. Of course, the fact that there may have been dry holes drilled in the vicinity is good evidence that the royalty is worthless and a quitclaim of such rights is also an indication of worthlessness and deduction on the tax return for that year can be claimed.

Another point to keep in mind is that Sect. 105 of the I.R.C. puts a ceiling on the surtax that is applicable to gains upon the sale of interests in oil and gas properties. The statute applies only to the individual who has established the value of that property by development work. If he should make the mistake of transferring his rights to a corporation first and then selling his stock in the corporation he would lose the availability of the Sect. 105 surtax ceiling.

Determining the cost of an interest is another fairly common question. Any bonuses paid for a lease must be capitalized. Attorney's fees paid to acquire a clear title to oil operating rights must be capitalized and intangible and development costs may either be capitalized or deducted currently at the operator's option. Geological costs must be capitalized, generally speaking.

Ordinary rentals and delay rentals are ordinary income and no depletion is allowed. If a landowner leases his land and receives $1 an acre rental, that is considered ordinary income and no depletion is allowed. If he later gets delay rentals on the lease then that is considered as ordinary income and no depletion deduction is allowed.

ACKNOWLEDGMENT

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Steel Shortage Worsens

▪ CONTINUED FROM PAGE 45

whereas many smaller companies, and particularly those who are new in the industry or whose pipe requirements vary greatly from year to year, do not have a continuing relationship and are the ones to feel the hardships first and to the greatest extent.

The Oil and Gas Field Materials Committee of the IPAA is making a survey of the oil field tubular goods supply problem. The preliminary results of this survey, based upon 250 replies from individual operators, show that producers have been forced outside the normal channels for about one-quarter of their requirements. For the fourth quarter of 1950 only 74 percent of requirements was obtained through regular channels. The gray market accounted for 7 percent; "conversion arrangements," 6 percent; "Oil for Steel" and other "tie-in" arrangements, 2 percent; second-hand materials, 9 percent; and imports of foreign made pipe, 2 percent.

The priliminary results of the survey further show that the hardships have been greatest on the smaller operators. Those using 200 tons or less per year were able to obtain only 42 percent through regular sources, being forced into unusual and increased cost arrangements for 58 percent of their needs.

Q. *What steps, if any, have been taken to improve the supply and/or the distribution of steel products for the industry?*

A. There have been a number of definite steps taken. In the first place, although the available supply has been inadequate, the steel industry has increased the total available to the oil industry.

The National Petroleum Council has been actively engaged in an effort to develop the facts with respect to this problem. Its comprehensive report on steel requirements for the oil industry has been furnished to the Petroleum Administration for Defense, the claimant agency for the oil industry on allocations and distribution of steel. Discussions are now being held between the PAD and the National Production Authority, the agency that has authority over steel allocations.

Another step toward improving steel distribution was the issuance of Order M-6 by the National Production Authority which requires steel producers to establish regular allotments of steel to distributors. This should aid in maintaining normal channels of supply.

Some steel companies themselves have taken definite action to correct the abuses in distribution. For example, one of them requires all purchasers of tubular goods to certify that their purchases are for their own needs and not for resale. This type of individual and voluntary action on the part of the steel industry is most helpful and if undertaken by a sufficient number of steel companies would go far in eliminating gray market and other distribution abuses.

Q. *What specifically do you recommend to meet the steel shortage problem?*

A. Our association, based upon the studies and recommendations of our Oil and Gas Field Materials Committee, has recommended a definite program which we believe would materially contribute to correcting the present situation, particularly the difficulties of distribution. The program adopted by our membership in October is as follows:

"(1) Allocate sufficient steels to meet the essential material requirements for petroleum exploration, development and production.

"(2) Distribute available supplies of oil field materials only for current use.

"(3) Establish regional pools of reasonable inventories for priority delivery by industry committees to meet essential needs of operators without established customer relationships and for unforeseeable and unscheduled drilling operations.

"(4) Avoid stockpiling of materials in short supply.

"(5) Encourage the most effective use of materials by the petroleum industry through cooperation with state regulatory bodies in the administration of state conservation programs."

We feel that to a great extent the maldistribution of available pipe can be corrected by voluntary action on the part of the oil and steel industries. Our association has urged the Secretary of Interior to consider voluntary action in this respect by initiating a joint conference of steel and oil industry representatives. To date the Secretary has not taken any action in this regard. We believe that this should be pursued as a means of solving a problem which today is the most serious one facing the domestic industry.

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Bureau of Mines Role in Secondary Recovery

Part 1

By R. A. CATTELL
Chief, Petroleum and Natural Gas Section
Bureau of Mines, Washington, D. C.

THE Bureau of Mines, U. S. Department of the Interior, through its Petroleum and Natural Gas Branch, has been active in secondary recovery research work for more than 30 years, even before the first Petroleum Station was established. Under an amendment to the Synthetic Liquid Fuels Extension Act, additional funds became available on July 2, 1948, making it possible to extend the scope of the work at Bartlesville, Okla., Laramie, Wyo., San Francisco, Dallas, and Franklin, Penn., field headquarters. It also enabled the Bureau to establish suboffices at Wichita Falls, Texas, and Bradford, Penn.

Cooperation in the secondary recovery research field has been widespread. In addition to financial support from such agencies as the State of Oklahoma, Kansas State Board of Health, Arkansas Oil and Gas Association, Pennsylvania Grade Crude Oil Association, and the North Texas Oil and Gas Association, the unstinted technical advice of the Secondary Recovery Advisory Committee of the Interstate Oil Compact Commission has been highly beneficial in maintaining an objective program and this has been supplemented by the aid and assistance of many agencies, companies and individuals.

Engineering field studies of secondary recovery operations are an important part of the Bureau's program and have been conducted in the Mid-Continent, Texas, California, Rocky Mountain and Appalachian regions. The Bureau has collected data on production histories and reservoir conditions of representative stripper fields and made results available to the oil industry and the public in a number of Reports of Investigations that describe those stimulative methods considered more efficient in producing oil under given conditions.

Engineering research on secondary recovery problems is diversified so far as individual problems are concerned, but in effect they are all closely related and the work at the several stations and offices is carefully correlated. The object of all of the studies is to obtain more stock-tank oil from stripper fields by more scientifically planned and engineered methods of production. For example, an intensive effort is being made to apply the science of rock physics to the shooting of oil and gas wells with explosives. Another important study on which Bureau engineers are working pertains to the selective plugging of strata in air-gas injection wells so that the injection medium will enter those parts of the sand body containing the most oil rather than bypass through the more permeable strata. Other engineering research includes studies of ways by which oil wells may be made to flow on gas-injection projects; studies of drilling fluids for cable tool coring; means of locating abandoned and improperly plugged wells that are always a source of trouble in old areas to be waterflooded; investigations of water conditioning for injection purposes; determination of the effects of dissolved gases on the corrosion of metal by water; studies of the effect of heat on oil recovery; research on the posibilities of heating oil sands by electromagnetic radiation; and use of radioisotopes as tracers for subsurface waters.

Another division in the Bureau's secondary recovery program includes work on the development of special techniques and tools and on laboratory analyses. This work is exemplified by core and water analyses, electric logging in shallow fields to find the tops and bottoms of the pay formations where well logs are missing or unreliable, electrical analogy flow studies, and the development of special tools which cannot be obtained through regular commercial channels.

These are some of the projects and problems which constitute the Bureau of Mines secondary recovery program designed to assist the oil industry in improving its techniques and obtaining more stock tank oil. Space will not permit a complete report on all of the Bureau's activities, but it is felt that a recapitulation of some of its secondary recovery activities will be of interest to the oil industry.

THIS DISCUSSION of the work of the U. S. Bureau of Mines on the subject of secondary recovery will be of particular interest to executives and independent producers, as it shows how the reader may benefit from the Bureau's research and cooperation. This article should be helpful to those who do not find time to read more detailed technical reports on what the Bureau is doing and how it can help them. This article is excerpted from Bureau of Mines Information Circular 7551 and Bureau of Mines Report of Investigations 4654.

Engineering Field Studies

As previously indicated, petroleum-engineering studies of stripper oil fields

suitable for the application of secondary recovery methods of production are an important part of the Bureau of Mines program related to secondary recovery studies. Reports of these studies that discuss the geology, development, exploitation, and predictions of performance under secondary recovery methods not only are invaluable to the operators in the fields studied but also serve as guides in many other fields.

Boggs Field, West Virginia

Recently, an engineering study of the Boggs field, Roane County, West Virginia, discovered in January, 1911, was completed by Bureau of Mines engineers. The report[1] gives an engineering appraisal of the 1428-acre field, its development and operation from date of discovery to date of probable abandonment, and estimates of the probable total volume of oil to be recovered and the quantity of oil remaining in the sand. Surface maps of the properties and isopachous and contour maps of the sand are presented. The engineering analysis shows that the cumulative oil production in 15 years of primary recovery operations amounted to only 8.54 percent of the original oil in place; that during both primary recovery and 19.5 years of secondary recovery gas-drive operations, 13.28 percent of the original oil was produced; and that, with 22 additional years of operation, using the same production techniques, the total volume of oil recovered would amount to only 15.25 percent of the crude oil originally in the reservoir.

This report significantly points out the need for unitization of leases in fields, particularly in the Appalachian Region, where secondary recovery techniques of operations must be relied upon to exploit stripper oil properties to obtain the greatest ultimate recovery. Even with the Boggs field operated as it was during the primary recovery period, a greater ultimate recovery of oil could have been realized by secondary recovery gas injection operations if the field had been operated under proved unitization principles and the same or greater volumes of gas injected into the reservoir through a greater number of wells. Furthermore, the recovered oil would have been produced in less time, thus saving part of the operational expense.

McDonald Field, Pennsylvania

The results of another engineering field study were reported[2] describing gas injection operations in southwestern Pennsylvania, where secondary recovery has not been practiced extensively or intensively. Secondary recovery operations were initiated in the McDonald field, Allegheny and Washington counties, Pennsylvania, in 1932. The project comprises 29 leases having an area of 3200 acres situated in the central portion of the 9000-acre field. Because of the shortage of cheap natural gas and the reluctance of the operator to contaminate the low-pressure natural gas in the reservoir with air, only 650,716 cubic feet of natural gas were injected into the sand at pressures ranging from 65 to 100 pounds per square inch gauge through 12 injection wells during the 10-year interval covered by the report. Although the injected volume of gas was small and spread over a large area, the oil production rate was stimulated on all 26 leases.

Atlanta Field, Arkansas

In June, 1949, the results[3] of a petroleum engineering study of the Atlanta field, Columbia County, Arkansas, were released. The Atlanta field is one in which fluid is being injected early in its life to effect a more efficient recovery of the contained oil rather than allow the reservoir pressure to drop to a point where much more energy is required to move the oil into the producing wells. The field, discovered in 1938, produces from the Smackover limestone at an approximate depth of 8200 feet. The original reservoir pressure was estimated to exceed 3800 psi, and water injection was started in 1946, when the average reservoir pressure had dropped to about 2900 psi. The Bureau's report of the Atlanta field, which is typical of a number of fields in southern Arkansas, may aid in oil conservation by careful evaluation of the several factors that did or did not contribute to greater oil recovery and by suggesting improvements in production methods and applications.

Healdton Field, Oklahoma

One of the larger projects initiated during the past year was a study of the Healdton field in Carter County, Oklahoma. This study should draw the attention of secondary recovery operators to this neglected area and provide many valuable data for future operations. The field includes 7500 productive acres on which 2570 wells have been drilled. Although it was discovered in 1913 and developed during the next few years, 73 new wells have been drilled during the past 3 years. Cumulative production from the field exceeds 200 million barrels, but much of the oil sand remains highly saturated. Gas injection as a secondary recovery method has been tested with varying success on seven leases in the field. The first project, started in 1928, utilized one well to inject about 30,000 cubic feet of gas daily into the Healdton sand, and during the first 18 months increases in oil production from 32 wells on 152 acres amounted to only 3200 barrels. Some of the succeeding projects were more successful, and some resulted in increases in oil recovery amounting to as much as 800 barrels per acre.

Weber Field, Oklahoma

A petroleum engineering study of the Weber field, Washington County, Oklahoma, will be of interest to hundreds of operators producing oil from the Bartlesville sand in many fields in Oklahoma and Kansas. Discovered soon after the turn of the century at a depth of approximately 1200 feet, it has been produced by gas injection for many years, but it is estimated that the recoverable oil that remains in the reservoir exceeds the oil that has been recovered from the field to date. Figure 1, showing the distribution of the original reservoir fluids, indicates that an average barrel of pore space in the reservoir originally contained 31 percent connate water and 60 percent oil. It is estimated that 15½ percent of the barrel represents stock tank oil already produced, 25 percent of the oil is not recoverable by present

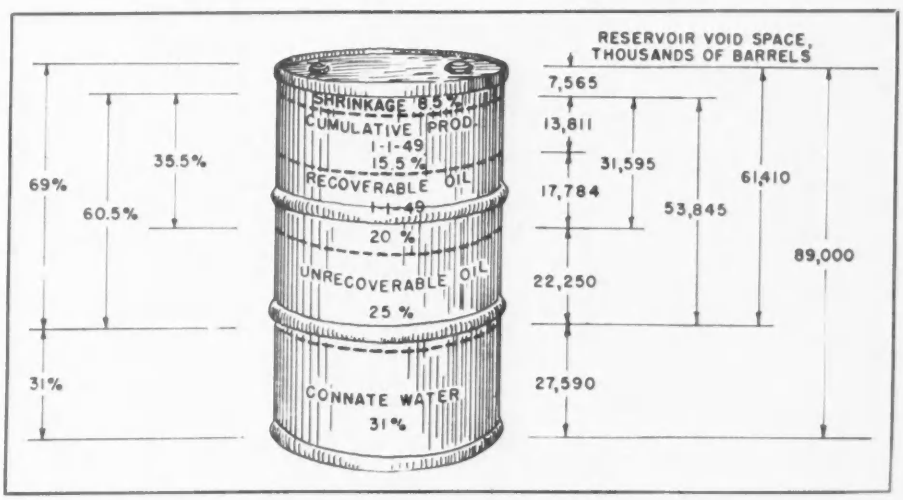


FIGURE 1. Schematic drawing showing fluid content of average barrel of pore volume in the Weber pool, Washington County, Oklahoma.

methods, and 20 percent is oil that may be recovered by efficient secondary recovery methods. This will represent nearly 18 million barrels of recoverable oil which, at present prices, is worth approximately more than $45 million.

(The Bartlesville Station has collected data and records from 144 Oklahoma water-flooding projects covering approximately 40,000 productive acres showing that 33½ million barrels of oil were produced in the state to the end of 1949 by water flooding. This information will be published as an up-to-date revision of an earlier Report of Investigations 3728, "History of Water Flooding of Oil Sands in Oklahoma," by D. B. Taliaferro and David M. Logan [1943] which, because of strong demand, has been reprinted and is now available for distribution.)

West Red River Field, Oklahoma

Based upon the results of an engineering study of the West Red River field, Oklahoma,[4] the following recommendations were made by Bureau of Mines engineers: (1) Unitization of lease ownerships, (2) raising fluid levels in the producing wells to control the repressuring medium more efficiently, (3) selective plugging off of highly permeable strata, and (4) switching gas input wells to obtain better distribution and spread of the repressuring medium. Thorough investigation of the possibilities of increasing ultimate oil recovery by water flooding was recommended. From the case history of this field, the authors were able to draw some conclusions and make certain recommendations that should be helpful to persons responsible for operating similar near-depleted fields in the contiguous North Texas region.

K.M.A. Field, Texas

At the request of the North Texas Oil and Gas Association's Secondary Recovery Committee, Bureau of Mines engineers have undertaken a study of units 5 and 6 in the southwestern portion of the K.M.A. field in Wichita and Archer counties, Texas. The area selected contains 12,000 acres controlled by 60 independent and major companies operating 135 leases. The K.M.A. limestone has been subjected to pressure maintenance by gas injection since 1940, and the wells in the two units are producing less than 10 barrels per well per day. High operating costs and a favorable tubular goods market have resulted in the plugging and abandonment of wells before improved methods of secondary recovery were applied. It is hoped that this study will suggest some method of economically recovering the oil that would be lost if the remaining wells are abandoned.

California Fields

Concrete developments aimed toward increasing ultimate oil recoveries from California fields by injecting gas and water into reservoir sands are increasing in number and extent.

In the past, petroleum engineers have stressed repeatedly that the problem of recovering additional oil in California by secondary recovery methods that have proved economically succesful in other areas cannot be applied without considerable modification to California's thick and complex sands of high permeability, yielding oils of high viscosity. Although the problems of recovering additional oil in California by secondary recovery operations once seemed insurmountable, studies of some of the existing pressure-maintenance and water-flooding projects demonstrate that stimulative procedures in selected areas may be applied successfully.

Four water-flooding projects currently are operating in California, in addition to 23 gas-injection operations in 19 fields. During the past year plans were consummated to study these projects as a first step in the Bureau's program of production research on secondary recovery of oil from California's stripper oil fields.

Experimental water flooding in the Chapman zone of the Richfield field, the most complete water-flooding project in California, has shown that water can be injected into the zone on a sustained basis and that the water will displace appreciable quantities of residual oil from the sand. Also, in the Greeley field, oil production from a number of wells has increased as a result of the flooding effect of water injected into the sand in a water disposal operation. In the Rio Bravo field, gas injection is supplementing the natural reservoir energy, and recovery efficiency has been improved by maintaining more favorable saturation conditions within the reservoir. The net gas-oil ratio since gas injection was begun is 67 percent less than the ratio before gas injection. As a result, an increase in ultimate recovery of oil is indicated.

FIGURE 2. Bureau of Mines engineers testing various types of equipment for detecting abandoned and improperly plugged wells. Left, M-scope pipe finder used to follow abandoned lead lines down to 18 inches underground. Right, Army mine detector to search for buried scrap usually found in vicinity of abandoned wells.

REFERENCES

[1] Tignor, E. M., Jennings, Thomas, and Krause, Leon, "Secondary Recovery of Oil and Gas Injection in the Boggs Field, Roane County, W. Va.": Bureau of Mines Rept. of Investigations 4430, 1949, 31 pp.

[2] Tignor, E. M., and Nabors, Wm. M., "Secondary Recovery of Oil in the McDonald Field in Southwestern Pennsylvania," *Producers Monthly*, Vol. 8, No. 6, April 1949, pp. 20-26, 6 figs.

[3] Riggs, C. H., "Petroleum-Engineering Study of Atlanta Oil Field, Columbia County, Ark.": Bureau of Mines Rept. of Investigations 4455, 1949, 55 pp.

[4] Hill, H. B., Johnston, Kenneth H., Coleman, T. L. and Seward, J. M., "Petroleum-Engineering Study of the West Red River Field, Tillman County, Okla.": Bureau of Mines Rept. of Investigations 4450, 1949, 97 pp.

Sand and Gravel in Deep-Water Deposits

By FRANCIS P. SHEPARD
Scripps Institution of Oceanography

THE discovery that coarse sediments possessing other supposed characteristics of near-shore shallow water conditions are being deposited in deep water hundreds of miles from the coast should lead to caution in the interpretation of facies from drill cores. Deep-water sands in the modern basins off Southern California are shown to resemble the deep-water clastics of the Ventura, Calif., area.

Until recently coarse sediments have been considered as indicative of shallow water deposition, although chance introduction of coarse material into deep water by some form of rafting has long been considered possible. Seventeen years ago Manley Natland[1] called attention[1] to Pliocene sandstones and conglomerates near Ventura, Calif., which had a Foraminiferal fauna indicative of origin at water depths greater than 6000 feet. At first little attention was paid to this seemingly extravagant claim and most geologists who were working with the Pliocene in the Los Angeles area continued to think of such coarse sediments as a near-shore facies. However, search by oil companies for the profitable beach sands adjacent to these coarse sediments has led to many dry holes since the beaches have not appeared.

The Geology division at Scripps Institution became interested in the problem as a result of Natland's examination of the Foraminifera from many of our cores. At his request the depth of the core was withheld from him until he had informed us of the depth zone to which he thought it belonged. His accurate diagnosis gave us confidence in his system of depth zonation. The study of recent marine Foraminifera along the east coast by J. A. Cushman, F. B. Phleger, and F. L. Parker gave further indication of depth zoning. Furthermore, extension of coring operations beyond the continental shelves into deep water has shown that sand layers are common, particularly in submarine canyons and along the base of the continental slopes. Pebbles comparable to those of the Ventura Pliocene conglomerates are found, although less commonly than the sands. Since the sand layers are interbedded with more normal deep water deposits there appears to be little doubt that the coarse material is actually transported into deep water.

IN EXPLORATION for petroleum it is important to know the direction of the shore line of the ancient deposits as well as its proximity, because bodies of sand commonly form along the shore as beaches, bars, or dune ridges, which may provide stratigraphic traps. Deep water sands have many features indicative of shallow water, such as good sorting, coarseness of texture, and even ripple marks and cross bedding. Therefore, considerable care should be exercised before concluding that coarse sediments were formed near the shore. **This is a contribution from Scripps Institution of Oceanography, New Series No. 494. This work represents in part the results of research carried out for the Office of Naval Research under contract with the University of California.**

Sand in deep water is found widely around the world. Excluding localities where its introduction appears to have been due to ice rafting, the world distribution is shown in Figure 1. The greater abundance in the equatorial Atlantic and along the coast of Southern California probably is only apparent since these areas have been explored to a greater extent than others. The lack of indications in some large areas of Figure 1 is probably due to lack of data.

Sand and gravel have been found in numerous cores taken from the axes of submarine canyons at depths ranging from a few feet out to 12,000 feet or more. The coarse materials are probably more common in those canyons which have heads extending in close to the present coasts. The basins and troughs of the sea floor off Southern California have yielded numerous sand layers in cores taken at a variety of depths down to 6000 feet. Cores from the Mediterranean taken by the Swedish Deep Sea Expedition have a large number of sand layers, some of them having been obtained well out towards the central portion of the basins and others near the slopes. Sand layers were found by H. C. Stetson and F. B. Phleger in the deep central basin of the Gulf of Mexico. Cores taken by Hans Pettersson, M. Ewing, H. C. Stetson, and C. S. Piggot in various portions of the Atlantic show that sands are widespread on the floors of that ocean. Many of them are found along the very gentle outer portion of the continental slopes hundreds of miles from shore. Others were obtained in the Romanche Deep and still others on the plains of the Bermuda Deep far from any known

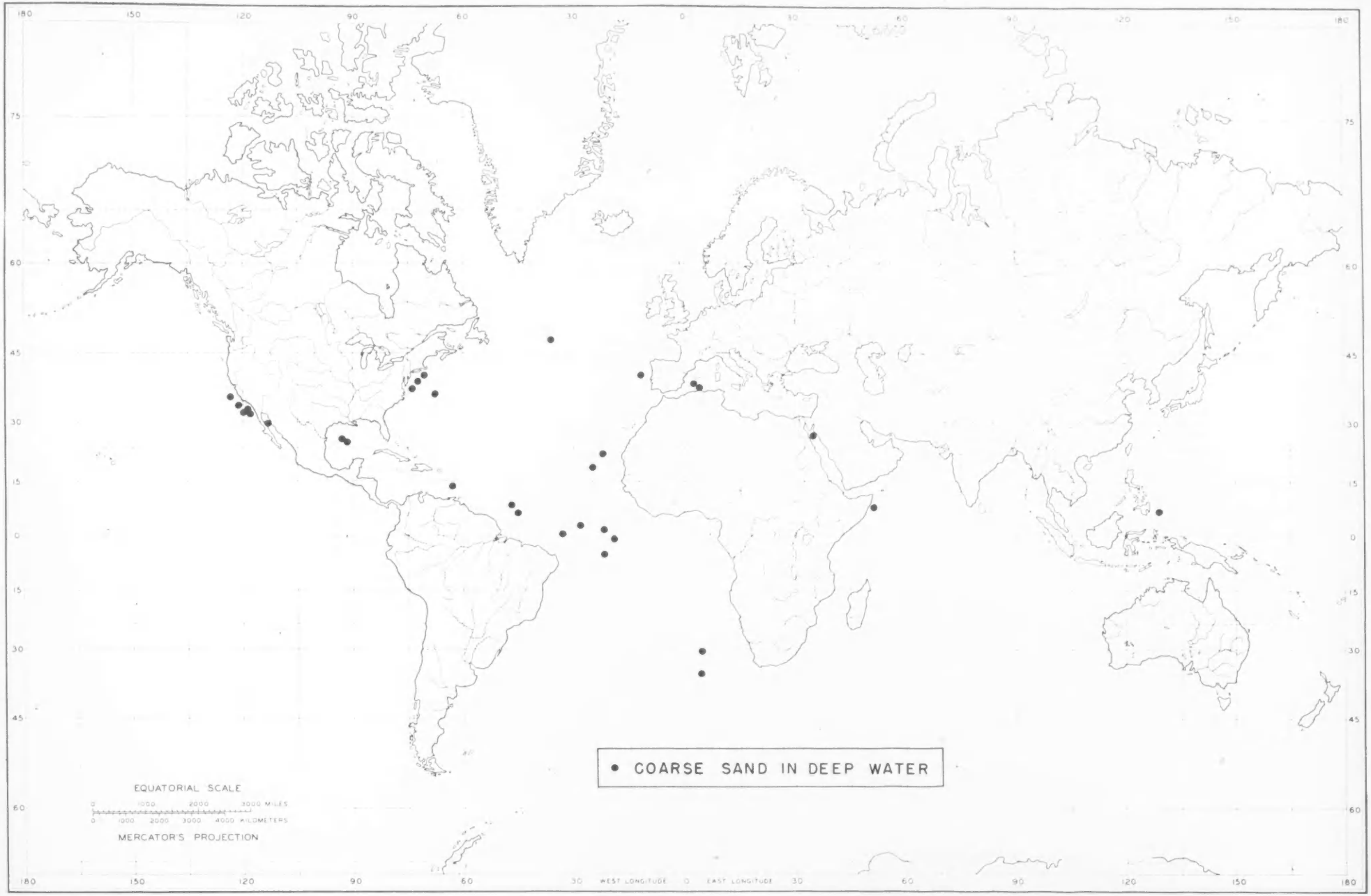
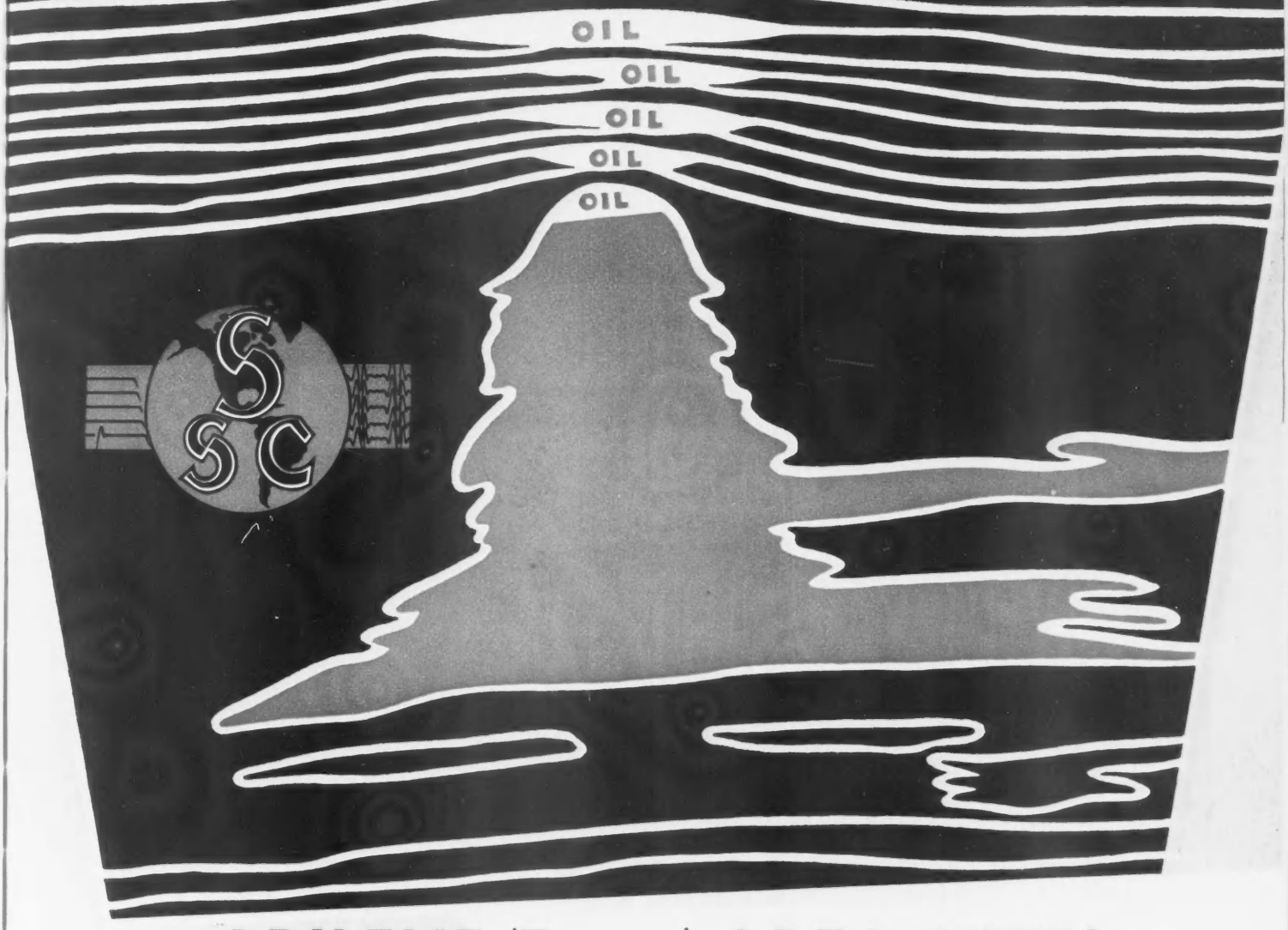

• COARSE SAND IN DEEP WATER
EQUATORIAL SCALE
0 1000 2000 3000 MILES
0 1000 2000 3000 4000 KILOMETERS
MERCATOR'S PROJECTION
180 150 120 90 60 30 WEST LONGITUDE 0 EAST LONGITUDE 30 60 90 120 150 180
75 60 45 30 15 0 15 30 45 60

FIGURE 1. Localities where deep-sea sand layers have been discovered. Most of information from Swedish Deep Sea Expedition and from cores obtained by *Atlantis* and *E. W. Scripps*.

Are you looking for Reefs?



ABILENE (Texas) AREA REEFS

The above sketch is an idealized conception of the general geologic features.

These reefs are of the pinnacle type with somewhat unusual conditions often existing in the interval between the base of the reef proper and limestone resting on underlying dolomite. The illustration shows a discontinuity in reefing conditions on one side during its growth.

Limes and sands draped over the reef are usually oil bearing. The occurrence of oil in the tip of the reef only may not ultimately apply to all reefs in this area.

Shallow draping and reef presence combine to aid in oil exploration in this general area. That is, a shallow drape structure may lead to reef discovery, or a known reef body may lead to a shallow discovery in the overlying draped beds.

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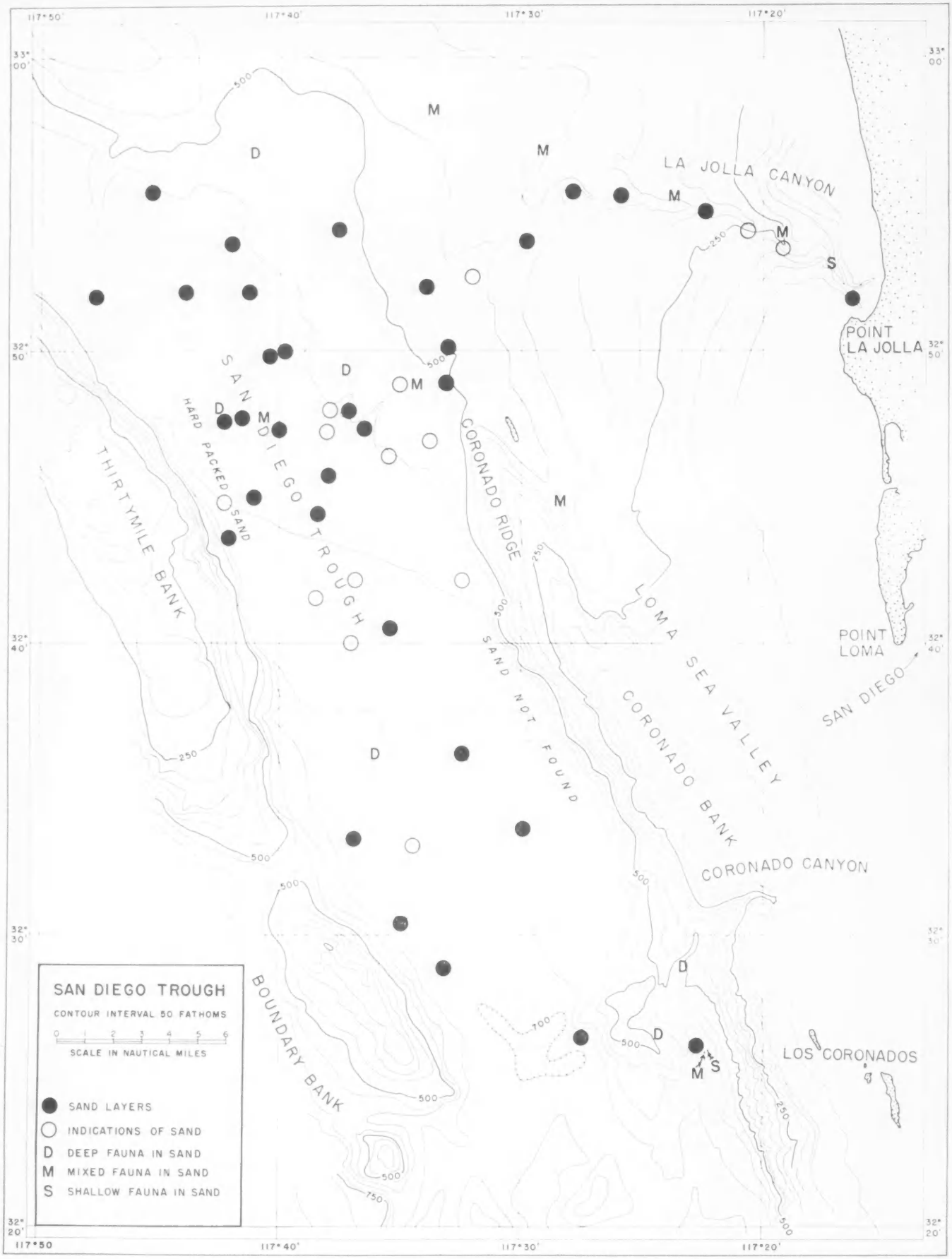

FIGURE 2. Localities where sand was obtained in San Diego Trough and the entering canyons. Foraminifera data supplied by F. B. Phleger. Note that the sand layers indicated by letters are the only ones from which diagnostic depth zone data have been determined.

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slope. Most of the sands of the deep Atlantic cannot be explained as ice berg deposits of glacial stages since they occur outside of the supposed limits of icebergs and are too well sorted for ice rafting.

The only deep water area from which an abundance of information is available is the San Diego Trough (Figure 2) which extends for 20 miles along the coast, is about six miles across, and an equal distance off the nearest part of the mainland, Point Loma (San Diego). The water depths in this trough vary between 3000 and 4500 feet so that they are not true oceanic depths but far deeper than the supposed depths of epeiric seas. More than half of 90 cores collected from the trough have either sand layers or sand lumps in them. For the most part the sand occurs below mud but a few cores have sand at the top. In most places one or more sand layers are found interbedded in mud (Figure 3). In one area, near the base of Thirty-mile Bank, the bottom appears to be a hard packed sand which has proven difficult to sample by corer, dredge, or snapper.

The sand is particularly abundant on the gentle slope around the outer portion of La Jolla submarine canyon. It has also been traced along almost the entire length of the axis of La Jolla Canyon from the shallow water sand area at the canyon head into the deep outer trough. Less sand has been found in Coronado Canyon (southeast portion Figure 2). Sand has not yet been found along the base of the steep slope outside Coronado Bank, but abundant sand appears in the center and western portion of the trough outside this bank. A smaller number of cores from the troughs off the Los Angeles area, partly taken by the Hancock Foundation of the University of Southern California, also show sand on the west and mud on the east side.

Characteristics of Deep-water Sand Layers

The only extensive analyses of deep-water sands are those by Ludwick[2] from the San Diego Trough, but a considerable number of others have been examined under the binoculars, and the median diameters and sorting coefficients are known from a few others. Many of these sands are fine-grained and well-sorted, differing little in general character from typical fine-grained beach sands. Analyses of portions of two deep Atlantic cores obtained by the Swedish Deep Sea Expedition showed that the sorting is increasingly poorer with depth of the sand in the core. The same variation in sorting was found in some deep water sands of the Ventura area. The sand layers appear to have sharp lower boundaries showing no gradation into the underlying muds, clays or oozes (Figure 3). The upper boundaries are either sharp or gradational. Some of the sand layers show a gradation from coarse material at the bottom to fine material on top, but such gradation is not readily evident from examination of the cores. The sand layers from San Diego Trough are considerably distorted. It seems likely that some of the sand is in the form of lenses or lumps. Sampling with a three-barreled coring device showed that in some places the layers pinch out in the few inches between barrels. Foraminifera and other organisms are in general far less abundant in the sand layers than in the interbedded mud layers.

Some cores from deep portions of submarine canyons contain much coarser sediment than is typical of the deep-water sand layers found in basins and troughs. These canyon samples show a gradation from pebbles underneath up into sand and mud at the top.

The marine cores resemble the deep-water formations described by Natland from the Ventura area. Some of the outcrops near Ventura show an alternation of sand and mudstone which appears to be identical with that found in so many deep ocean cores. The marine cores differ, however, in having less coarse material and fewer examples of conspicuous graded bedding. The ripple-marked surfaces found on some of the Ventura formations have not yet been discovered in the deep-water sands. New methods of exploration will be necessary before their existence can be ascertained.

Displaced Faunas of Deep-sea Sands

The Foraminifera contained in many of the sand layers have been studied by Phleger.[3] He has found that there is much evidence of displacement of faunas such that benthonic Foraminifera which live only in shallow water environments are found in the deep-water sand layers. These shallow-water forms are almost always mixed with deep-water types. The displaced faunas have been found in the submarine canyons and in the basins and troughs off Southern California, in the Sigsbee Deep of the Gulf of Mexico, in the open Atlantic hundreds of miles out from the northeast coast of South America, and in the basins of the Mediterranean. Some of them may have been introduced during the cold stages of the Pleistocene but others are distinctly of recent origin.

Several different faunal relations are indicated in Figure 2. It will be noted that only a deep fauna occurs in some of the sand layers well out from the submarine canyons, whereas either a mixed shallow and deep fauna occurs in the canyons or an

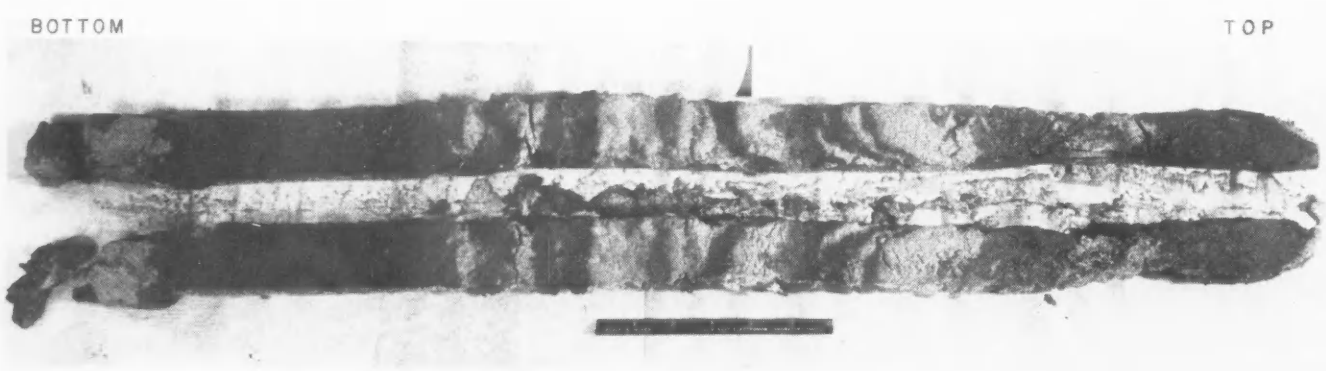
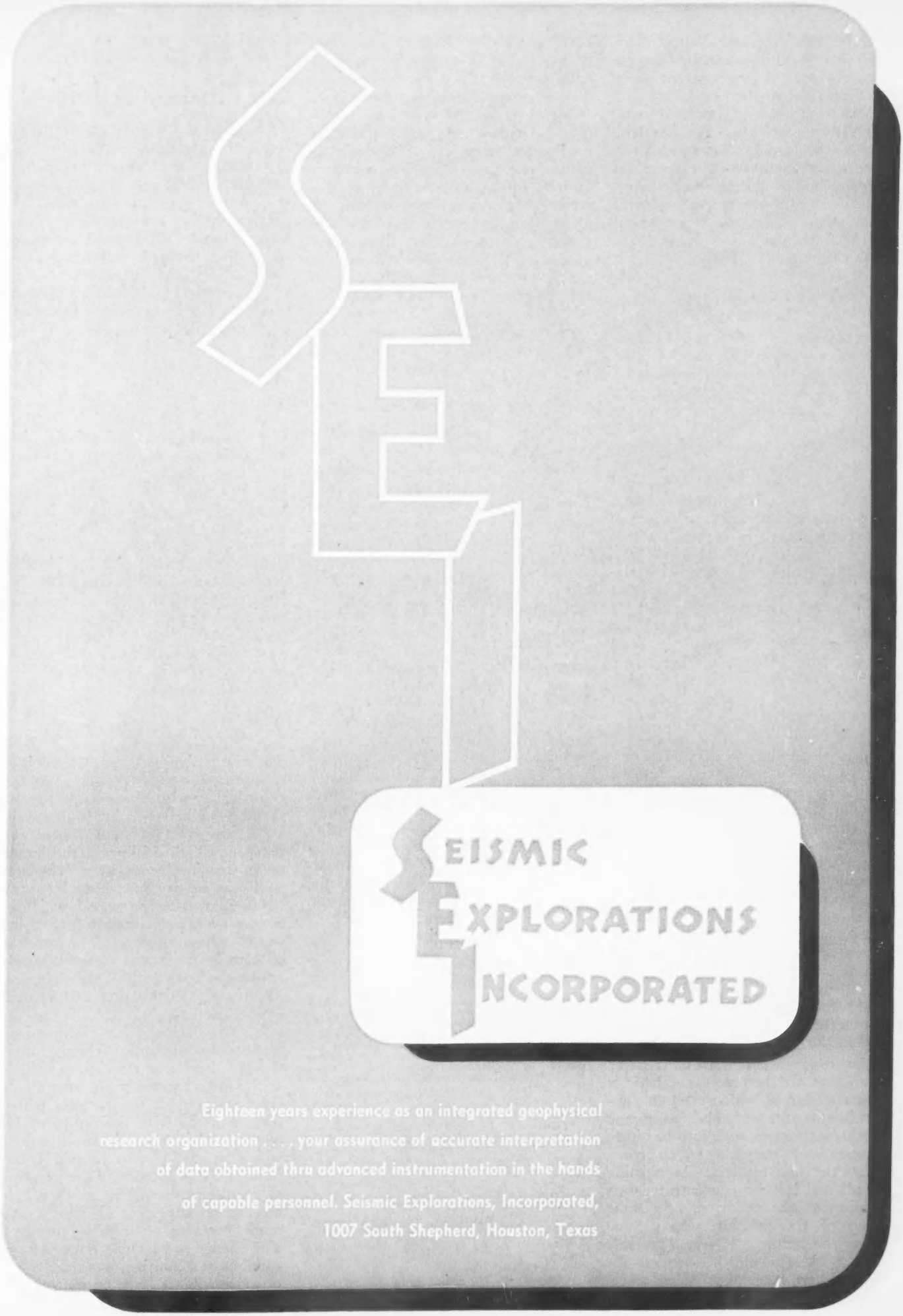


FIGURE 3. The two halves of core obtained in 331 fathoms off La Jolla. The light-colored layers are sand and the dark mud. Note the disturbed layers are bent in the wrong direction to indicate disturbance during the coring operation.



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unmixed shallow-water fauna. The latter was found in Coronado Canyon relatively near the escarpment leading down from the shelf off Los Coronados Islands. Associated with these shallow-water Foraminifera were echinoids and moluscs which are distinctly of shallow-water type. The material consists largely of organisms with smaller amounts of mineral sands. Similar shell sands are found on the outer shelf and upper slope in this area.

Transportation of Sand Into Deep Water

In an article in WORLD OIL for December, 1949[1] reference to the deep-water sand layers was included and a suggestion of ocean currents or wind storms was offered as a possible explanation. Recent exploration appears to rule out wind storms as a cause. The coarseness of some of the layers, notably those from submarine canyons, is quite out of line with material carried by the wind. For example, most of the sand is coarser than the material which falls on the Atlantic Ocean outside the Sahara Desert. Also the thick sand layers found recently at distances of hundreds of miles from the coast, could scarcely be the work of wind storms, particularly since they were obtained off tropical areas of high rainfall where no wind transport would be expected.

Slumping of sediment in submarine canyon heads has been studied for the past 15 years in the Southern California area. There is no doubt that the sand carried along the shore and deposited in the canyon heads is subject to occasional slides outward along the steep axis. These slides prevent the filling of the canyon heads which extend in very close to the shoreline. Slumping can certainly carry coarse sediments down the canyon axes and down the continental slopes. However, it would be most surprising if this slumping alone could form well-sorted sand layers out on the flat portions of the troughs and in the basins of the deep ocean.

An explanation which can be offered as the best now available is that the slumps which start in canyon heads, and probably also on the continental slopes, turn into turbidity (suspension) currents which carry away the fine materials in swirling clouds and leave a concentrated suspension of the sands, and in some cases of the pebbles, which flows along the bottom. It seems unlikely that pebbles could be carried far beyond the base of a steep slope. However, experiments by Kuenen[5] have shown that in tanks, concentrates of sand in suspension currents will move well out over horizontal floors before deposition takes place. It seems likely that it is these turbidity currents which are responsible for the deep sand layers. The mixing of shallow and deep Foraminifera faunas within the sands may be the result of picking up Foraminifera along the course of the turbidity current or may be due to the carrying of shallow faunas unmixed out into deep water and the growth of deep-water faunas on the sand layer before it has been covered by normal deepsea muds. Careful studies of the sand layers will probably provide the answer to this alternative.

Economic Significance

In the search for petroleum it is considered important to know the direction of the shoreline of the ancient deposits as well as its proximity because bodies of sand commonly form along the shore as beaches, bars, or dune ridges which may provide stratigraphic traps. Since the deep-water sands have many features indicative of shallow water origin, such as good sorting, coarseness of texture, and even ripple marks and cross bedding, considerable care should be exercised before concluding that coarse sediments were formed near the shore. Perhaps the best means of separating shallow from deep-water sands is by a study of the fauna. If the formations are as recent as Pliocene, the depth zonations of recent Foraminifera can be applied. Shallow sands are much more likely to have cross bedding and lense structures. Deep water sands are usually interbedded with very fine sediments characteristic of deep water and the lower boundary of the sand is abrupt, whereas the boundary is likely to be somewhat gradational in shallow-water deposits.

ACKNOWLEDGMENT

The information presented here is a summary of results obtained through recent investigations by several members of the staff and students of the geology division of Scripps Institution, including F. B. Phleger, J. C. Ludwick, J. D. Frautschy, and D. L. Inman. Important information has also been supplied by Dr. Hans Pettersson, Maurice Ewing, H. C. Stetson, Roger Nevelle, K. O. Emery, and R. S. Dietz.

REFERENCES

[1] Natland, M. L., (1933), "The Temperature and Depth Distribution of Some Recent and Fossil Foraminifera in the Southern California Region," *Scripps Inst. Oceanogr., Univ. Calif., Bull., Tech. Ser.*, Vol. 3, No. 10, pp. 225-230.

[2] Ludwick, J. C., (1950), "Deep Water Sand Layers off San Diego, California," Doctoral Thesis, *Scripps Inst. of Oceanog.*

[3] Phleger, F. B., (1950), "Displaced Foraminifera Faunas," to be published by *Jour. Sed. Petrol.*

[4] Shepard, F. P., (1949), "Submarine Geology and Stratigraphy," WORLD OIL, Vol. 129, No. 9, Dec., 1949, pp. 72-77.

[5] Kuenen, Ph. H., and C. I. Migliorini, (1950), "Turbidity Currents as a Cause of Graded Bedding," *Jour. Geol.*, Vol. 58, No. 2, pp. 91-127.

Use Imagination, Oil Finders Advised

Ira H. Cram of Houston, vice president in charge of exploration for Continental Oil Company and a former president of the American Association of Petroleum Geologists, believes geologists and geophysicists can become better "oil finders" by broadening their outlook and using more imagination. This challenge to become more imaginative when viewing a drilling prospect was issued to about 1200 geologists and geophysicists during a Joint Regional Exploration meeting of AAPG and Society of Exploration Geophysicists in Fort Worth.

Cram told the exploration men that if the industry is to maintain its high level of oil production, geologists must take more chances. They must face the fact that prospects cannot be turned down because they do not happen to be backed up by a "pretty picture." This statement will undoubtedly be hailed with considerable satisfaction by wildcatters who trudge from office to office of major companies in an attempt to interest the geological department in drilling a prospect which "looks good" but cannot be contoured and closed handily on the regional map.

Continuing the theme, Cram said that it is not a matter of whether the industry can afford more "imaginative wildcatting"; it must afford it if new reserves are to be found at a pace comparable with the expanding demand for oil. Cram put it this way:

"A given set of facts becomes a prospect worth drilling in the hands of an imaginative explorer. The first well may be dry as a bone but may point the way to the second, which in turn may blaze a trail to the third wildcat and a discovery. The same set of facts in the hands of an unimaginative explorer is just something to fill the already bulging and insufficiently used files."

In conclusion, Cram emphasized that geologists must "change their specifications" for excuses to drill if they are to explore more adequately large portions of the nation's petroliferous areas with their present kit of tools. The change in specifications which he has in mind, he said, is not new; and it is not simply the lowering of requirements so that every wiggle on the geological and geophysical maps becomes a drillable prospect. The change to which he refers is more fundamental and involves the drilling of more wildcat wells on more imaginative prospects.

The swamp buggy is ready to propel itself across a small stream in a snake-infested swamp. The homemade boat in the right background is a pirogue, also found handy by prospectors seeking oil in swamp lands.

OIL is where you find it; and sometimes you find it under water. That is especially true in the delta country of southern Louisiana. There, prospectors using the latest scientific devices seek oil bearing formations deep under the watery swamps.

In such explorations home-made vehicles called swamp buggies, or, more properly, marsh buggies, provide transportation for men and materials. They are not made for paved road, but in a pinch will travel on them. In soggy fields and marshy swamp lands, which are more water than soil, they really get around.

The swamp buggy, except for its wheels, resembles a conventional tractor. Wheels are replaced by gigantic circular pontoons. Metal, riveted and air tight, has been found the best material for these hollow, buoyant wheels with diameters of seven feet. And for extra grip in soggy going the front pontoons have extra size wooden, paddle-like cleats. These swamp buggies, which can move hub deep through marshes, have front wheel drives, with chain transmission from engine to pontoons.

Sometimes oil companies own factory made swamp buggies. More often, like this one used by a seismograph party, they are rented from the owner-builder-operator. That provides a form of upkeep insurance. In the event of mechanical breakdown, often deep in the swamp, the man who built the contraption is best able to get it back into operation without loss of valuable time.

See Photos on Next Page →

Above. The swamp buggy is in the picture as a seismograph party's surveyors lay a line in the swamp.

Above. Having hauled a pontoon supported drilling rig into position, the buggy moves off across the swamp.

Left. This buggy is laying a recording line along a swampy path.

Below. The swamp buggy, one wheel showing, drags boats holding prospecting crew and supplies through a southern Louisiana swamp.

Below. Visible is a bit of the wheel of this buggy dragging drill stem and other prospecting supplies through the tall cutgrass and hyacinths.

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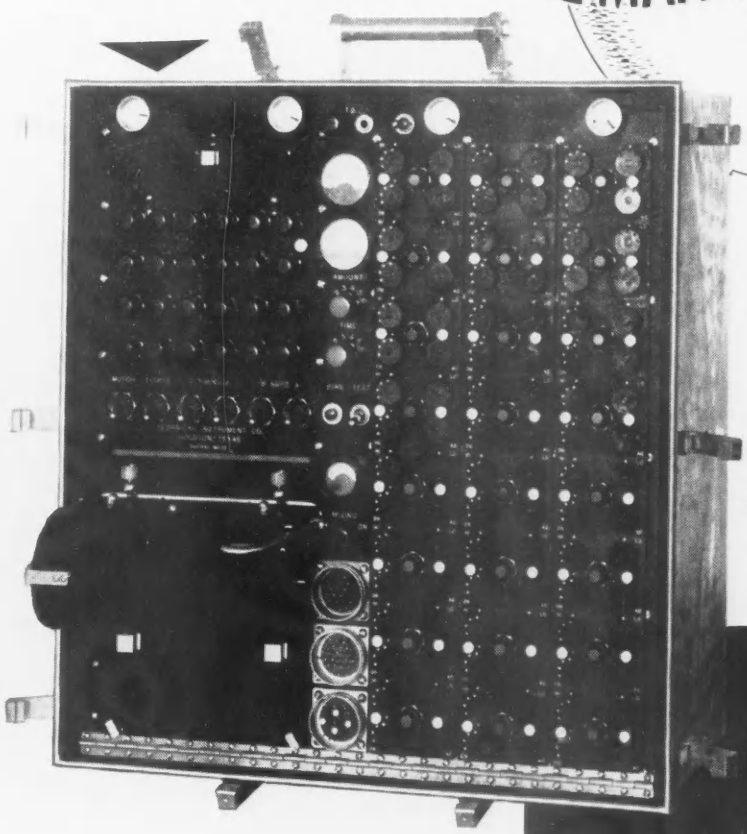

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Oil Possibilities of *Niagaran Reefs* in Illinois

By DR. ALFRED H. BELL

Geologist and Head, Oil and Gas Division, Illinois State Geological Survey

ALTHOUGH the ability of limestone reefs to trap oil has been known for many years, it is only in the last two or three years that the oil industry has become widely reef-conscious. The reef character of Permian limestone oil fields in West Texas and New Mexico has been known since about 1927. The discovery of major oil fields in Devonian limestone reefs in Alberta, Canada—Leduc, Redwater, etc—and in what are considered to be Pennsylvanian reefs in Scurry County, Texas, has caused the exploration branch of the industry to become strongly interested in the reef occurrence of oil.

The oil accumulations in some older producing fields, which were long considered due to structures caused by diastrophic movements, have more recently been found to be due to reefs. In some of these, as for example in the Sandoval field, Marion County, Illinois, the principal oil accumulation is in beds of later age than the reef. These beds are "draped" over the reef and reflect its structure.

In Illinois the first occurrence of oil in a reef to be recognized as such was in the Marine pool, discovered in 1943, in Madison County, about 25 miles from St. Louis. Reports on the geology and development of the Marine pool have been published from time to time.

The present article is in the nature of a review of Illinois Geological Survey Report of Investigations No. 145, "Niagaran Reefs in Illinois and Their Relation to Oil Accumulation," by Dr. H. A. Lowenstam, which was published in February, 1950. The concluding part of Dr. Lowenstam's report, entitled "Niagaran Oil Possibilities," is here quoted. The distribution of Silurian rocks and of Niagaran reefs in the Great Lakes region is shown in the index map, Figure 1.

"In Illinois the Silurian rocks which show the greatest promise as oil reservoirs are the Niagaran reef lenses. Oil production from the Niagaran reefs of Illinois is of two distinct types. The reef rock itself may act as the reservoir, or overlying Mississippian and Devonian formations may produce oil from the structures formed as a result of differential compaction over the rigid reef bodies.

"Oil has been produced from Devonian and Mississippian rocks above several known Niagaran reefs: Marine, Sandoval, Bartelso, and McKinley. It appears quite possible from a study of the structural relations as shown on upper horizons that certain other pools, such as Tonti and Patoka, may be underlain by Niagaran reefs.

"The bulk of the oil produced at Marine has been directly from the Niagaran reef body. In addition, an undetermined proportion of the Devonian production at Bartelso has been from Niagaran reef rock, and some of the Sandoval production may have been from the underlying reef. Niagaran oil is being produced from the reef at McKinley pool, Washington County.

"As the Niagaran reef production found to date has come from the large reefs near the reef front, and as there are considerable areas near the projected portion of the reef front in which the Niagaran is still untested, it appears that further major Niagaran oil production is most likely to be found in the southeasternmost part of the reef-bearing area (Figure 2). It should be pointed out that there is little control for the location of the reef front between western Marion County and Coles County. The actual front is presumably sinuous in this region, showing extensive embayments and prominent reef bastions as it does in the area to the southwest and northeast in which it can be mapped with greater accuracy.

"It is theoretically possible that some reef outliners occur south of the archipelago border, as reef development might have started there during the relatively clear-water phase of St. Clair deposition.

"The northeastern limit of the area of greatest likelihood of Niagaran reef production is the LaSalle anticlinal belt, as it appears that all commercial oil has been flushed from reefs on and beyond this structure. That commercial oil at one time was present in the Niagaran reefs of the LaSalle anticlinal belt and of the Chicago outcrop area is indicated by shows of residual "dead" oil through 200 feet of the Niagaran reef pen-

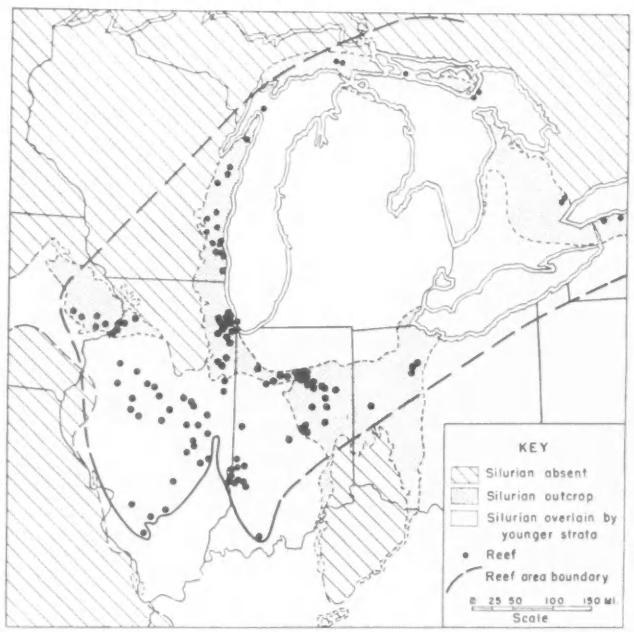

FIGURE 1. Distribution of Silurian strata and location of known reefs. (I.S.G.S. R.I. 145, Figure 7.)

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etrated three miles north of Tuscola in Douglas County, by similar shows in Champaign and Ford counties wells, and by the well known asphalt occurrences in the outcropping reefs of the Chicago area.

"Northwest of the belt of greatest reef development and preservation is a parallel belt which presents fair possibilities for reef production (Figure 2). It seems likely that the reefs in this area were smaller than those closer to the front, and in addition they must have been truncated by pre-New Albany as well as pre-Middle Devonian erosion.

"Deeply eroded reefs may be present and may produce oil in the central Illinois area with poor possibilities (Figure 2). In addition, it is largely within this area that porosity and permeability related to erosional surfaces may be expected in various nonreef Silurian rocks, with the possibility of light oil production.

"The points of greatest significance in the search for further Niagaran reefs may be summarized as follows: The reef-rock proper always consists of practically pure carbonates, either limestone or dolomite, that have higher electrical resistivity than normal interreef rocks. Reef dolomites are invariably blue-gray in color, coarse-grained, and vesicular. Reef limestones are pink to white coquinas, formed almost exclusively of coarse unsorted fossil debris in which corals and stromatoporoids are important constituents. Chert is never present. The two reef rocks are replaced by varied impure carbonate rocks in the common interreef areas. The Niagaran rocks are abnormally thick at reef cores.

"In the critical area for oil production where the Moccasin Springs formation is present, reef proximity may be most easily recognized by an abnormally thin section of Bainbridge red-colored beds closest to the reef and by abnormally thick red-colored sections at some distance to the lee of the reef. Fingers of well sorted fossil debris, chiefly crinoidal but containing noticeable amounts of coral constituents, extend some distance from the reef. Although certain interreef beds may approach these fingers in purity and in fossil density, the coral content is a reliable index for reef proximity. Relative purity of the Niagaran section in general strongly suggests nearness to a reef. All these criteria for reef proximity are applicable only within the southern two-thirds of the low-clastic reef-bearing belt indicated on Figure 3, as they cannot be applied when the interreef sediments as a whole become

FIGURE 2. Silurian oil possibilities. (I.S.G.S. R.I. 145, Figure 9.)

relatively pure and the red Moccasin Springs formation becomes patchy toward its feather edge.

"Structural highs occur in the beds that overlie reefs, due to the thicker reef section and to the compactibility of the interreef sediments. These structural highs imperfectly reflect the reef topography and outline, and therefore bear only coincidental relation to the normal regional pattern of deformation structures. In general, alignment of reef structures may be more or less parallel to the reef front. Known structures in higher beds which do not fall into the regional structural framework should be re-examined for possible reef influence. In some instances there may be superposition of reef-controlled structures on deformational structures.

"As reefs would not influence the structure of underlying beds, seismographic reflections from the "Trenton" will not indicate the presence of Niagaran reefs, although seismographic records of horizons above the Niagaran should prove useful. Gravity anomalies have proved successful in locating Permian reefs in West Texas, but it is not known whether there is sufficient difference in the density of reef and interreef Niagaran sediments to produce recognizable anomalies. The physical property of reef-rock which appears to offer the greatest possibility for direct geophysical detection is its electrical resistivity, which averages several times greater than that of the typical interreef sediments.

"Figure 3 indicates all known reefs in the area critical for oil production, although it is not complete for some areas in western Illinois. In addition it indicates a number of occurrences of reef flanks and reef-influenced interreef deposits in wells in the critical area. The most important of these near-reef occurrences can be summarized.

"Kingwood Oil Company's Gaffner 1, SW SE NE-30-6m-3w, Bond County, penetrated reef outwash containing fragments of reef-building corals and well assorted crinoidal coquina. It therefore appears likely that the nearby gas-bearing Ayers structure is developed over a ridge-shaped Niagaran reef.

"Three wells in northwestern Montgomery County, Gulf's Brandon 1, 1-10n-5w, Central Pipe Line's Gees 1, 35-11m-5w, and The Texas Company's Long 1, 27-11m-5w, are all within the inner zone of reef influence, as indicated by the fact that the Moccasin Springs formation has been replaced by reef outwash and unusually pure low-clastic dolomite and dolomitic limestone. Of the three wells, Gulf's Brandon 1 appears to be closest to the reef, because it has a thin St. Clair section and contains the greatest amount of reef outwash. The presence of this postulated reef is strengthened by the occurrence of 50 feet of normal Moccasin Springs strata in Alan's Ward 1 in 23-12m-5w, eight to nine miles from the other wells and in the direction in which the Moccasin Springs formation is regionally disappearing. This last well is in the outer zone of influence in which clay-sized clastics and reef outwash are dumped in the lee of the reef.

"Continental Oil Company's Beachy 1, in 13-15n-6e, Moultrie County, penetrated 160 feet of reef core and reef outwash and an additional 20 feet of reef-influenced sediments beneath the reef material. This would indicate that the reef began its growth not at the location of the Beachy well, but at some other point nearby. This reef is indicated on the regional reef distribution map of the second Marine pool report.

"Carter's Brauer 6, in 21-8n-3e, deep test in the northern part of the Louden pool, penetrated interfingering reef outwash and core rock as well as interreef sediments.

"Pray's Baker 1, in 17-18n-6e, Piatt County, penetrated a section of reef core, with outwash above and below. Numerous wells in the LaSalle anti-

clinal belt from Coles County north penetrated reef core, outwash, or both.

"The map (Figure 3) showing reef distribution indicates other occurrences in which the evidence of reef proximity is doubtful, consisting only of unusually pure limestone or dolomite, whose relative purity may be due to admixture of reef-derived carbonates, or may indicate only normal sedimentary variations.

"Possibilities for oil production from Silurian rocks other than the Niagaran reefs may be summarized briefly. Reservoirs of low permeability and consequent light oil or gas production may be developed in a number of Niagaran and Alexandrian rocks by post-Niagaran erosion and weathering. Suitable structural or stratigraphic trap conditions have localized pools within the belt where pre-New Albany erosion has laid bare the Silurian rocks. Oil production at Mount Auburn in Christian County and Collinsville in Madison County, oil shows in the Silurian of Sangamon and Morgan counties, and gas production at Pittsfield, Pike County, are of this type. It is to be expected that similar light production will be found in the future in the region of west-central Illinois in which the Niagaran is less than 250 or 300 feet thick (Figure 4).

Two oil fields in Illinois discovered after Report of Investigations 145 was prepared are probably reef accumulations. They are Elbridge in Edgar County, productive in the McClosky limestone at an average depth of 950 feet and in the Devonian limestone at average depth of 1950 feet, and Weaver in Clark County, productive in the Devonian limestone at an average depth of 2040 feet. These two fields are in the vicinity of several Indiana oil fields which are also believed to be reef occurrences (e.g. Siosi, Prairie Creek, etc.).

Geophysical methods, including seismograph and gravity meter, are credited with a number of successes in the discovery of buried reefs in Illinois and Indiana. However, as is abundantly indicated in Dr. Lowenstam's report, the discovery of a buried reef does not necessarily find oil in commercial quantities. Because of the shallow depth of the Niagaran limestone in much of Illinois and Indiana, the expense of test drilling is comparatively small.

There is activity in Illinois and Indiana in geological and geophysical investigations to explore for buried reefs. Prospects seem good for the discovery of additional oil-bearing reefs.

ACKNOWLEDGMENT

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REFERENCE

1 Illinois Geological Survey Report of Investigations 114, "Marine Pool, Madison County—A New Type of Oil Reservoir in Illinois," H. A. Lowenstam and E. P. DuBois, 1946; and Report of Investigations 131, "Marine Pool, Madison County, Illinois—Silurian-Reef Producer," H. A. Lowenstam, 1948.

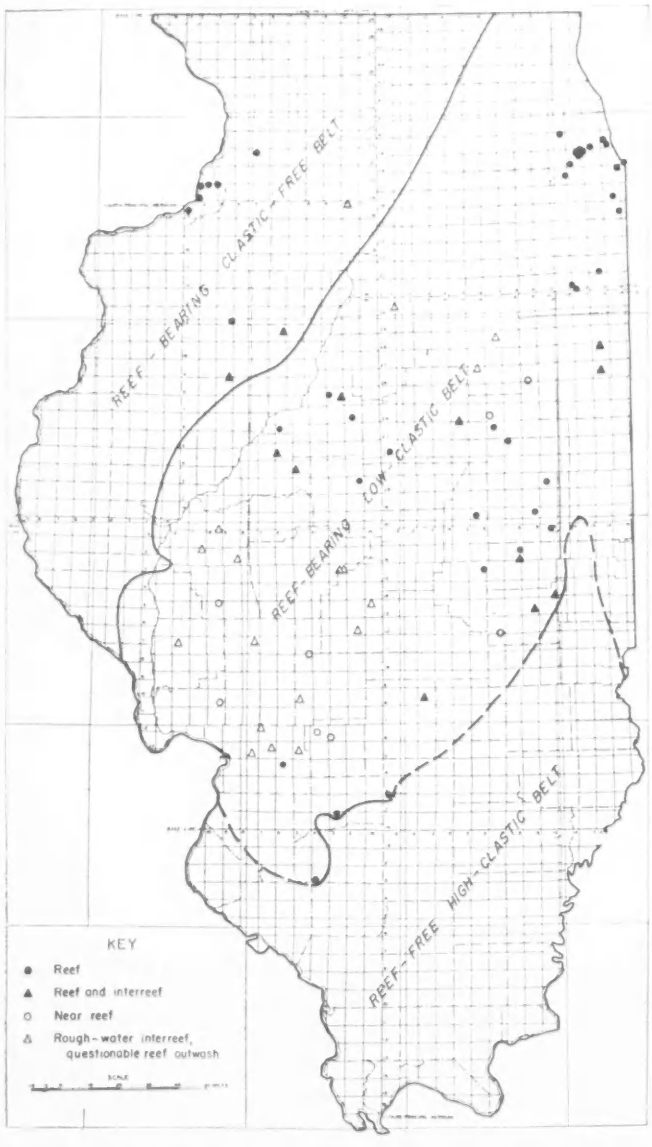


FIGURE 3. Niagaran reef occurrences and sedimentation belts in Illinois. (I.S.G.S. R.I. 145, Figure 6.)

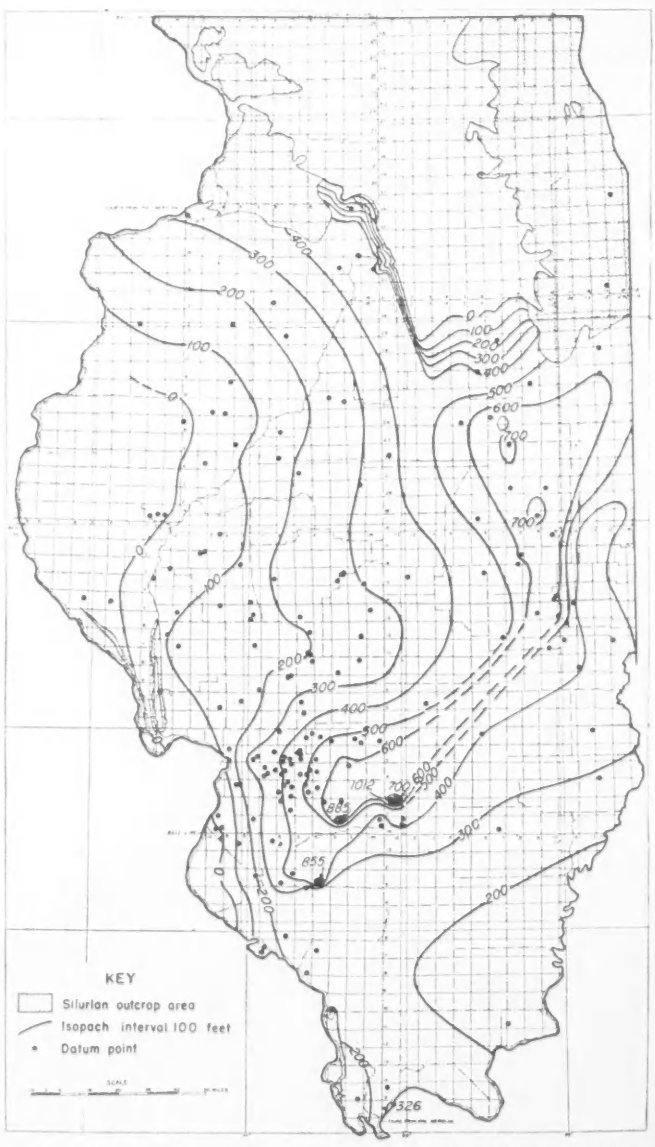


FIGURE 4. Thickness of Niagaran strata in Illinois. (I.S.G.S. R.I. 145, Figure 4.)

the A-1 answer to

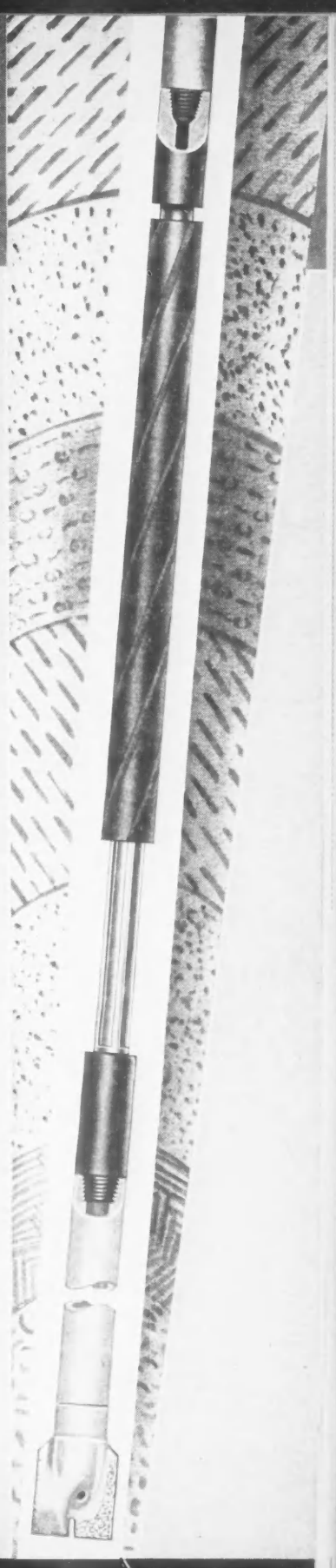
Key Seat trouble

REDUCE DRILLING COSTS

by using

BURRIS KEY SEAT WIPER

Positively Prevents Sticking in Key Seats



A-1 BIT AND TOOL COMPANY

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LOUISIANA
Lafayette
Houma
New Orleans
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CALIFORNIA
Los Angeles
Baash-Ross Tool Co.

ILLINOIS
Olney

WYOMING
Casper
Baash-Ross Tool Co.
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Oklahoma City

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Calgary and Edmonton

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Exploration

Record Shattered

IN THE first 11 months of 1950, the U. S. industry drilled more exploratory wells than it had ever done previously in an entire year. The all-time high mark for exploratory drilling had been 7721 wells completed in 1949, and the old year's 11-month mark topped that peak by 212 tests and there still remained another month of drilling. Only in total wells has 1950 been out in front, as the results have not been quite as good, at least from a numerical standpoint.

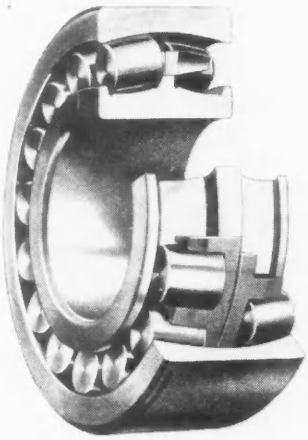
Exploratory wells drilled totaled 7933 through November, while in 1949 the total was 7721 for the entire year. However, in 1949, the successful tests totaled 1589 for a score of 20.6 percent of the total drilled. Best efforts in 1950 produced 1525 successes for a count of 19.2 percent.

ITEM	Nov., 1950	Oct., 1950	ELEVEN MONTHS January-November 1950	1949	Percent Diff.
Oil Discoveries	91	112	1,006	892	+ 12.8
New Fields	61	84	738	611	+ 20.8
New Pays	30	28	268	281	— 4.6
Distillate Discoveries	6	9	81	116	— 30.2
New Fields	6	6	64	66	— 3.0
New Pays		3	17	50	— 66.0
Gas Discoveries	11	14	135	165	— 18.2
New Fields	9	13	118	119	— 0.9
New Pays	2	1	17	46	— 63.1
Total Discoveries	108	135	1,222	1,173	+ 4.2
Extensions to Fields	24	32	303	295	+ 2.7
Oil Fields	21	28	267	246	+ 8.5
Distillate Fields	3	1	12	15	— 20.0
Gas Fields		3	24	34	— 29.4
Total Prod. Tests	132	167	1,525	1,468	+ 3.9
Dry Holes	618	675	6,408	5,602	+ 14.4
Wildcats	608	633	6,142	5,411	+ 13.5
New Pays		1	8	41	— 80.5
Outposts	40	41	258	150	+ 72.0
Total Exploratory Tests	780	842	7,933	7,070	+ 12.2
Percent Productive	16.9	19.8	19.2	20.8	
Percent Dry	83.1	80.2	80.8	79.2	

(See tables on pages 82-84.)

Results of Exploratory Drilling in November and First Eleven Months, 1950-1949, by Districts

STATE or DISTRICT	MONTH OF NOVEMBER, 1950													FIRST ELEVEN MONTHS, 1950																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Total Productive		Unproductive Tests				Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions									
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	11 Mo. 1950	11 Mo. 1949	Wildcats	New Pays	Outposts	Total Dry 11 Mo. 1950	Total Dry 11 Mo. 1949	11 Mo. 1950	11 Mo. 1949
Alabama											2			2	1		1							2		18			18	11	20	11
Arizona											3			3												8			8	5	8	5
Arkansas	2						1			3	5			8	8	1		1			2			12	14	75		2	77	72	89	86
California	1			4			1			6	28		9	43	16			1	9		1	19		3	49	39	315	3	35	353	347	402	386
Colorado	2									2	2			4	7			1			1			1	10	1	43		3	46	42	56	43
Florida																										8			8	14	8	14
Georgia																										4			4	4	4	4
Idaho											1			1												5			5		5	
Illinois	2		1	1		1	8			13	76			89	22		1	20		1	64		2	110	106	664			664	564	774	670
Indiana	3			1						4	14			18	38			8			5			51	47	396		15	411	353	462	400
Kansas	7		1	1						9	59			68	92		6	2			2			102	86	572			572	374	674	460
Kentucky	4			1			1			6	8			14	16		1	3			3			23	30	91			91	123	114	153
Louisiana	1								2	3	17		4	24	28	9	2	17	9	3	9	4	2	83	105	213	1	6	220	207	303	312
North Louisiana	1								2	3	14		2	19	12	1		2	4	3	5	2	1	30	31	111	1	4	116	115	146	146
South Louisiana											3		2	5	16	8	2	15	5		4	2	1	53	74	102		2	104	92	157	166
Maryland																		1						1	1	3			3		4	1
Michigan	1			1			1			3	34			37	27			5	3		1	3		39	26	280			280	283	319	309
Mississippi											9		1	10	9	2		1					2	14	8	125	1	4	130	107	141	115
Missouri																										6			6	13	6	13
Montana	2									2	8			10	2						2		1	5	8	54		1	55	35	60	43
Nebraska											5		1	6	3			4			3		1	11	1	53		1	54	7	65	8
Nevada											2			2												2			2		2	
New Mexico							2			2	6			8	11			2	5		10			28	23	64		6	70	57	98	80
New York																									1				13		14
North Carolina																													1		1
North Dakota																													4		4
Ohio											1			1							2		2	4	9	14			15	34	18	43
Oklahoma	3	1	3	1			3			11	41			52	66	3	9	27	1		40	1	2	149	124	476			476	410	625	534
Oregon																													1		1
Pennsylvania																		1						1	18				27	1	45
South Dakota											1			1												7			7	6	7	6
Tennessee																										4			4	37	4	44
Texas	33	5	3	21		1	4	1		68	271		23	362	380	49	80	161	7	10	97	5	10	799	742	2533	2	171	2706	2277	3505	3019
Dist. 1 S. Central				2						2	24			26	14	2	1	2	1	1	1			22	21	187		3	190	217	212	238
Dist. 2 Middle Gulf	2	1					1	1		5	15		6	26	15	10	16	11	2	4	1	3	4	66	69	142		22	164	147	230	216
Dist. 3 Upper Gulf	2	3	2	5		1				12	25		2	39	19	16	6	40	2	3	13	2	4	105	109	213		16	229	222	334	331
Dist. 4 L. Gulf SW	1	1		7						9	29		5	43	22	9	19	43	2	2				97	107	260		13	273	303	370	410
Dist. 5 E. Central											7			7	5	1	1	1			1			9	5	66			66	67	75	72
Dist. 6 Northeast	1									1	6			7	8	4		4			4		2	22	20	72	1	5	78	69	100	89
Dist. 7-B N. Cent.	8			2			1			11	58			69	135	3	17	12			11			178	147	567		19	586	514	764	661
Dist. 7-C W. Cent.	1		1	1						3	24			27	23	3	5	9			7			47	42	193	1	19	213	97	260	139
Dist. 8 West	10			3			2			15	34		4	53	59		1	30			36			126	93	275		23	298	176	424	269
Dist. 9 North	8		1	1						10	46		6	62	79	1	14	9			23			126	125	546		51	597	444	723	569
Dist. 10 Panhandle											3			3	1									1	4	12			12	21	13	25
Utah											2			2				2						2	3	15			15	21	17	24
Virginia																									4				2		6
Washington															1									1		1			1	1	2	1
West Virginia																									31				25		56
Wyoming											13		2	15	11		3	9			6			29	34	93	1	14	108	125	137	159
Total U.S.	61	6	9	30		2	21	3		132	668		40	780	738	64	118	268	17	17	267	12	24	1525	1468	6142	8	258	6408	5602	7933	7070



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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in United States in November, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Fields						
Miller		Stanolind's Miller Ld. & Lbr. Co. A-1, 20-18s-27w	11-26-50	6515	6303- 6312	Rodessa li; L. Cre.	F 200; 25 wtr; 3/8"	38.2
Union	"Trail"	El Dorado Drlg. Co. et al's Sallie Irby 1, (OWWO), C NE SE 22-18s-17w	11-21-50	4094	4002- 4006	Travis Peak sd; L. Cre.	P 236	43
		ARKANSAS—Oil Field Extension						
Union	Urbana	Pan Am. Southern's Tucker 1, C SE SW NE 8-18s-13w. 1½ mi w ext.	9-16-50	4008	2544- 2552	Meakin sd; U. Cre.	P 8; 109 wtr	
		CALIFORNIA—New Oil Field						
Los Angeles		Los Nietos Co's Edwards 1, Sect. 1-2n-10w	10-16-50	5722	3931- 3980		P 32	23.9
		CALIFORNIA—New Oil Pays						
Kern	Edison, S.	Franco-Western Oil's Frick 84-34, Sect. 34-30s-29e	11- 2-50	4075	3989- 4075	Schist sd; Jur.	P 25; 288 wtr	23
Kern	Midway-Sunset	General Pet. Corp's Ethel D-101, Sect. 36-12n-24w	11-24-50	4043	2710- 2870	Miocene sd; Mio.	P 40	18.7
Los Angeles	Seal Beach	J. L. M. Pet. Co's Freeman 1, Sect. 3-5s-12w	11-23-50	6100	5531- 6100		P 200	24
Santa Barbara	S. Cuyama	Richfield Oil Corp's Hibberd 22-6, Sect. 6-9n-26w	11- 9-50	4262	4170- 4260	Hibberd sd.; Mio.	F 249; 5/16"	35.2
		CALIFORNIA—Oil Field Extension						
Kern	Buena Vista Hills	Standard of Calif.'s "23-B" 44, Sect. 23-31s-23e. ½ mi sw ext.	11-25-50	2992	2894- 2992	Pliocene	P 127	27.1
Weld		Shell's Hulda A. Hanson 1, NE NE NE 33-8n-59w	11- 2-50	7254	6710- 6722	Muddy sd; L. Cre.	P 32	38.7
Logan		Shell's Green 1, SW NW NW 30-9n-53w	11- 9-50	5410	4866- 4885	Muddy sd; L. Cre.	F 360	
		ILLINOIS—New Oil Fields						
Gallatin	Ab Lake, W.	Cox & Vandenbark's L. Drone 1, NW SE NW 31-8s-10e	11- 7-50	2754	2727- 2732	Aux Vases sd; Miss.	P 38	
Jefferson	Reservoir	Gulf's Ill. Cities Water Unit 1, NE SE NW 28-1s-5e	11- 7-50	2629	2618- 2622	McClosky li; Miss.	P 10; 22 wtr; 3/4"	
		ILLINOIS—New Oil Pay						
Hamilton	Cantrell, S.	J. A. Wasson's Carlisle 1, NW SE SE 7-7s-5e	11- 7-50	3327	3323- 3327	McClosky li; Miss.	P 62	
		ILLINOIS—Oil Field Extensions						
Clay	Sailor Springs, N.	George & Wrather's H. Ditter 1, NE SE SE 18-4n-8e. 1¼ mi w ext.	11-21-50	3045	2992- 3002	McClosky li; Miss.	P 3; 68 wtr	
Effingham	Louden	Claypool Drlg. Co's J. W. Doty 1 (OWWO), NW NW NE 7-8n-4e. ¾ mi e extension	11- 7-50	1600	1560- 1590	Cypress sd; Miss.	P 6; 25 wtr; Pkr 6"	
Hamilton	Rural Hill	Stewart Oil's N. Porter 1, NW SW SE 1-6s-5e. ¾ mi n ext.	11-14-50	3218	3173- 3214	Aux Vases sd; Miss.	P 200; 40 wtr	
Gallatin	Inman, E. Cons.	J. L. Crawford's Patterson 1, SE SE NW 4-8s-10e. ½ mi nw ext.	11-14-50	2459	2449- 2456	Cypress sd; Miss.	P 25	
Gallatin	Inman, W. Cons.	Oil Management's Schmitt 2, SW NE SE 27-8s-9e. ¾ mi s ext.	11- 7-50	2806	2789- 2802	Aux Vases sd; Miss.	P 60; 8 wtr	
Wayne	Clay City-Noble Cons.	D. Hopkins' S. Redd 1, NW SW 6-2s-7e. 1 mi sw ext.	11-28-50	3343	3334- 3343	McClosky li; Miss.	P 8; 21 wtr	
White	Concord Cent.	Ashland-Buchman-Fisher's W. L. Clark 4, NE SW NW 9-7s-10e. ½ mi w extension.	11-21-50	3013	2604- 2610	Cypress sd; Miss.	P 24; 50 wtr	
White	Herald	Miami Operating Co's J. A. Sutton 1, NE NW SE 8-7s-9e. ¾ mi w ext.	11- 7-50	3072	3062- 3068	McClosky li; Miss.	P 150	
		ILLINOIS—New Gas Field						
Richland	Claremont	George & Wrather's W. Malone 1, SW SW NW 17-3n-14w	11-14-50	3315	3198- 3203	Rosiclare li; Miss.	F 2.8 mln	
		ILLINOIS—New Gas Pay						
Edgar	Grandview	C. H. Murdock's Bartmes 2, SE NW SE 5-12n-13w	11-21-50	572	568- 572	Salem li; Miss.	F 0.1 mln	
		INDIANA—New Oil Fields						
Daviess		E. Michel's Caswell Woodruff 1, NW SW SW 34-5n-6w	11-14-50	1101	1080- 1101	Salem li; Miss.	P 8; 100 wtr	
Gibson		J. F. Howard's J. Pauley 1, SW SW NE 20-1s-10w	11-11-50	1989	1978- 1989	McClosky li; Miss.	P 110	
Vanderburgh		Skiles Oil's J. W. Shrode 1, NE SW SW 18-6s-11w	11-15-50	2367	2358- 2367	Cypress sd; Miss.	P 63	
		INDIANA—New Oil Pay						
Knox	Monroe City, N.	Graham Dev. Co's Anna E. Myers 3, Mil Don 38, Sect. 1-2n-9w	11-21-50	1668	1665- 1668	Rosiclare li; Miss.	P 50	
		KANSAS—New Oil Fields						
Barber	Gerlane	Continental's Cavin 1, SW SW NW 29-33s-11w	11-21-50	4616	4601- 4616	Mississippian li; Miss.	P 30	22.8
Barton	Cheyenne View, N.	Aladdin Pet. & Crowe Drlg's Habiger 1, SW SW NW 1-19s-12w	11-24-50	3430	3116- 3192	Lansing-KC li; Penn.	P 118	
Barton	Roessler, E.	Hall & Branine et al's Roessler 1, NW NW NW 13-18s-11w	11-14-50	3298	3295- 3298	Arbuckle li; Ord.	P 220	
Ellis	Lookout Hollow	Ben F. Brack's Ruder 1, NW NW NE 31-14s-18w	11- 7-50	3636	3628- 3636	Arbuckle li; Ord.	P 21	
Stafford	Max, S.	Petroleum, Inc's Fruehauf 1, NE SW SW 15-22s-12w	11-21-50	3700	3329- 3346	Lansing-KC li; Penn.	P 284	
Stafford	Pundsack, N.W.	Stanolind's Foster 1, NE NE SE 24-21s-14w	11- 7-50	3733	3512- 3522	Lansing-KC li; Penn.	P 118	20
Stafford	Van Winkle, S.E.	Murfin Drlg. et al's Pelter 1, NW NW SE 26-21s-14w	11-20-50	3797	3569- 3595	Lansing-KC li; Penn.	P 230	
		KANSAS—New Oil Pay						
Pawnee	Rutherford, E.	Ben F. Brack's Hankin 1, (OWDD), NE NE SW 4-20s-21w	11-15-50	3755	3707- 3755	Arbuckle li; Ord.	F 280	
		KANSAS—New Gas Field						
Ford		Rufus Clay's Birney 1, C SW NE 2-28s-21w	11-23-50	5046	4954- 4986	Mississippian li; Miss.	F 12 mln	
		KENTUCKY—New Oil Fields						
Daviess		F. Haynes & G. Morgan et al's J. D. Benningfield 2, 20-P-32	11-12-50	1065	1060- 1065	McClosky li; Miss.	P 5	
Henderson	Oak Grove	R. E. Hupp et al's J. O. Sawyer 1, NW NW NE 22-P-25	11-20-50	2338	2312- 2334	McClosky li; Miss.	P 60	
Henderson		R. F. McMahan et al's H. B. Hazelwood 1, NW NE NE 17-P-26	11-29-50	1519	1516- 1519	Tar Springs sd; Miss.	P 85	
Webster	Poole	Iley Browning's Crowley Hrs. 1, NE NW NW 14-N-23	11- 3-50	1911	1888- 1900	Tar Springs sd; Miss.	P 65	
		KENTUCKY—New Oil Pay						
Henderson	Zion	F. M. Ashby's D. A. Neal 1, SE SE NE 3-P-25	11-12-50	2218	2204- 2218	McClosky li; Miss.	F 1060	
		KENTUCKY—Oil Field Extension						
Daviess	Cane Run	Catron-Legg's Magomkirk 1, N-31. 1 mi s extension	11-20-50	567	553- 567	Jett sd; Miss.	P 6	
		NORTH LOUISIANA—New Oil Field						
Concordia	Fairview	Sinclair's R. B. Sharp et al 1, Sect. 10-4n-9e	11-20-50	7498	6699- 6708	Campbell sd.; Eoc.	F 268; 3/16"	43.9
		NORTH LOUISIANA—Distillate Field Extension						
De Soto	Spider	Phillips Pet. Co's Deas 1, Sect. 32-12n-14w. 1 mi nw ext.	11-20-50	6263	6096- 6112	Pettit li; L. Cre.	F 11, 14 S mln.	
Lincoln	Unionville	Southwest Gas Prod. Co. et al's W. A. Colvin 1, Sect. 6-19n-2w. ½ mi w ext.	10-10-50	9500	8750- 8770	Vaugh sd; Jur.	F 76; 5 mln; 3/8"	55
					9170- 9186	Feazel sd; Jur.	F 265; 2 mln; 1/2"	52
		MONTANA—New Oil Fields						
Rosebud		Farmers Union Cent. Exch.'s Sawyer 1, C NE SW 26-11n-32e	10-15-50	5277	5255- 5277	Heath sd; Cre.	P 222	31.6
Rosebud		Texas Co's State 1, SE SE NW 36-11n-33e	11- 1-50	5475	4298- 4483	Amsden sd; Penn.	Sw 17; 4 wtr	
		MICHIGAN—New Oil Field						
Allegan	Dunningville	P. K. Degenther's State-Heath 1, SE SE SW 22-3n-14w	11-10-50	1438	1424- 1438	Traverse li; Devo.	P 120	
		MICHIGAN—Oil Field Extension						
Roscommon	St. Helen	Sun's State-Richfield D-2, N½ NW SW 25-24n-1w. ½ mi se ext.	11- 3-50	4285	4285	Richfield li; Devo	F 2; 2 wtr	
		MICHIGAN—New Gas Field						
Antrim		Ohio's State-Custer 1, NW SW NW 16-29n-7w	10-14-50	2918	1070- 1080	Traverse li; Devo.	F 3.1 mln	
		NEW MEXICO—Oil Field Extensions						
Lea	Brunson	Tidewater's State 3-S, C NW NE 15-21s-37e. 1 mi n ext.	11-22-50	7629	7550- 7612	Ellenburger li; Ord.	F 324; 5/16"	42
Lea	Denton	Ralph Lowe's Dickenson 1, C SE SW 35-14s-37e. 1½ mi n ext.	11-27-50	12385	12248-12385	Devonian li; Devo.	F 960; 5/16"	44.5
		OKLAHOMA—New Oil Fields						
Oklahoma		Harper-Turner's Delay 1, SW SW SW 2-14n-2w	11-10-50	6155	6142- 6155	2nd Wilcox sd; Ord.	F 45; 3/4"	38.1
Pawnee		Trigg Drlg's Weier 1, SE SE NW 21-20n-8e	11- 7-50	2623	2563- 2575	Red Fork sd; Penn.	P 4; 10 wtr	38.5
Payne		Foster Drlg's Wilson 1, SW SW SE 11-18n-6e	11- 7-50	3157	3151- 3157	Burgess sd; Miss.	P 21	39.8
		OKLAHOMA—New Oil Pay						
Payne	Norfolk	R. L. Kemp's Houston 1, NE NE NE 14-18n-5e. ¾ mi s of prod.	11- 7-50	3486	3184- 3200	Red Fork sd; Penn.	P 38	38.2
		OKLAHOMA—Oil Field Extensions						
Garvin	Antioch, N.E.	Deep Rock's Kahn-Hamilton 1, SE SE SE 11-3n-2w. ¾ mi e ext.	11-14-50	5735	5635- 5663	2nd Bromide sd; Ord.	F 480; 1/4"	44

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in United States in November, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
Major	Ringwood	R. M. Burk's Bierig 1, NE SW NW 8-21n-10w, south extension	11- 4-50	7260	6853- 6980	Manning sd; Penn.	F 158; $\frac{4}{32}$"	
Marshall	Aylesworth	Hubert E. Bale's Pure-Drummond 1, NE SE NW 10-6s-6e, northwest ext.	11- 3-50	3417	3169- 3330	Bromide sd; Ord.	P 80	36
		OKLAHOMA—New Distillate Field						
Coal	Oconee, E.	J. A. Roberson's Pepe 1, C W½ SW NE 34-1n-9e	11-21-50	7299	7228- 7245	McLish sd; Ord.	F 367; 28 mln open	58
		OKLAHOMA—New Gas Fields						
Lincoln		Wilcox Oil's C. Potter 1, SW SW SE 21-16n-3e	11-20-50	5004	4760- 4780	Hunton li; Sil.	F 6 mln.	
Okfuskee		Mid-Continent's Scott 1, NW SE NE 29-10n-10e	11-14-50	4254	3870- 3890	Hunton li; Devo.	F 42 mln; open	
Pontotoc		Bourse & Showalter's Larmons 1, NW SW NW 16-4n-5e	11-12-50	898	873- 898	Cleveland sd; Penn.	F 4.8 mln; 1"	
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Pay						
Atascosa	Charlotte	Humble's Emilia Lujan 2, (OWWO); Jno. Noble Sur. 1438	11-27-50	7014	6435- 6475	Austin ch; U. Cre.	P 56	37.9
McMullen	Dilworth	H. R. Smith & Am. Republic's J. C. Dilworth, Jr., 2, R. Vasquez Sur.	11- 7-50	5876	5435- 5441	Wilcox sd; Eoc.	F 146; $\frac{5}{32}$"	42
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
DeWitt	"Duff"	Hawn Bros. et al's Schaefer 1, Jas. Duff, Sur. A-153	11-13-50	8000	7610- 7614	Wilcox sd; Eoc.	F 161; $1\frac{5}{8}$"	35
Goliad	Terrell Point, W	Paul J. Fly et al's Lula Swickheimer et al 1, W. P. Patterson Sur.	11-27-50	4863	4654- 4662	B. Frio sd; Olig.	F 136; $\frac{5}{32}$"	26.4
		TEXAS—District 2 (MIDDLE GULF)—Oil Field Extension						
Calhoun	Melbourn	Alcoa Mining et al's L. J. Foester Sr. 1, Blk 12, Day L&C Sur. ¾ mi ne ext.	10- 2-50	9250	8545- 8547	Frio sd; Olig.	F 12	43.6
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Field						
Calhoun		Wm. Herbert Hunt's W. L. Traylor 1, Phillip Dimmitt Sur.	11-15-50	9384	8816- 8823		F 19; 0.5 mln. open	47.5
		TEXAS—District 2 (MIDDLE GULF)—Distillate Field Extension						
Goliad	Weser	Superior's Wm. F. Albrecht 1, Thos. Hancock Sur. ¾ mi ne ext.	11- 3-50	8079	7872- 7890		F 98; 3 mln; $\frac{1}{4}$"	56.8
		TEXAS—District 3 (UPPER GULF)—New Oil Fields						
Liberty		British American's W. P. H. McFaddin et al 1, Jas. McFaddin Sur.	11-15-50	6572	5856- 5864	Frio sd; Olig.	F 135; $\frac{5}{16}$"	30
Newton		Houston Oil Co. et al's Earl C. Hankamer 1-A, R. L. White Sur.	11-13-50	7320	7198- 7199		F 241; $\frac{5}{32}$"	38.6
		TEXAS—District 3 (UPPER GULF)—New Oil Pay						
Austin	New Ulm	Wood Pet. Co's Donnesle 1, Thos. Hill Sur.	11- 6-50	10826	9781- 9809	Wilcox sd; Eoc.	F 200; $\frac{3}{4}$"	49.9
Brazoria	Nash	Dan J. Harrison, Jr's Belle Wisdom Est. 6, H. M. Cleveland Sur.	11- 8-50	4304	4281- 4300	Miocene sd; Mio.	F 109; $\frac{3}{4}$"	20.3
Chambers	Winnie, N	Sun's Tyrell Tr. 5, T&NO RR Sur.	11-22-50	9150	8341- 8346		F 180; $1\frac{5}{8}$"	38.6
Orange	Orange, S.	W. V. Bowles & Co's Frank Granger et al 1, (OWWO); Wm. Dyson Sur.	10- 9-50	4901	4433- 4437		F 113; $1\frac{5}{8}$"	26.9
Wharton	Gobbler Cr.	M. T. Grubb et al's Weinheimer 1, Lyman Conkrite Sur.	11-21-50	5240	4227- 4230		F 115; $\frac{6}{4}$"	26
		TEXAS—District 3 (UPPER GULF)—New Distillate Fields						
Jefferson		Sun's Aubey 1, Jno. J. French Sur.	9-29-50	8600	8370- 8378		F 272; 7.4 mln.	63.8
Newton		E. C. Hankamer et al's H. L. Brown 1, Jas. Henderson Sur.	11- 3-50	7740	7198- 7226		F 690; 34.5 mln.	62.6
Wharton		Tidewater's R. G. Womack 1, J. F. Stevenson Sur.	11-26-50	7825	7086- 7098		F 266; 14 mln.	53.3
		TEXAS—District 3 (UPPER GULF)—New Gas Field						
Liberty		Texas Co's J. D. Williams et al 3, H&TC Sur. 123	10-31-50	2551	2136- 2146		F 20 mln; open	
		TEXAS—District 3 (UPPER GULF)—New Gas Pay						
Brazoria	Collins Lake	McCarthy O&G Corp's M. J. Jamison Est. 1, C. Smith Lge. 1 mi ne ext.	11- 1-50	11475	11424-11475	Hackberry sd; Olig.	F 95 mln; open	
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Field						
Jim Hogg	"Bruja Vieja"	Pontiac Refining Corp's Y. Vela Cuellar 1, W. M. Clay Sur. 576. 18 mi sw Hebbronville.	8-15-50	1761	1755- 1761	Cole sd; Eoc.	P 5	18
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Pays						
Brooks	Palo Blanco	Howeth & Mason's Kathleen J. Alexander 3-M, Los Mogueyes de Palo Blanco Gr.	11-18-50	4746	4716- 4728	1st Sojita sd; Olig.	F 136; $\frac{8}{8}$"	42
Duval	Charamoosca, N.	Dulaney Oil Co's DCRC 8, CCSD&RGNG Sur.	11- 4-50	2093	1995- 1998	U. Rosenberg sd; Eoc.	F 45; $\frac{1}{8}$"	31.7
Hidalgo	Donna	Sinclair's Gomez Unit 1, Sect. 18, Alamo Ld & Sugar Co. Subd.	11- 4-50	9250	6428- 6435	Gomez sd; Olig.	F 247; $\frac{7}{32}$"	42
Jim Wells	Tijerina-Canales-Blucher	Texas Co's H. C. De Tijerina 57, AB&M Sur. 359	10-31-50	7350	6920- 6930		F 266; $\frac{1}{8}$"	41.7
Nueces	Mustang Is.	Renwar Oil Corp's State Tr. 2-460, Corpus Christi Bay, State Tr. 460	11-14-50	7932	7610- 7624	Frio sd; Olig.	F 189; $\frac{11}{64}$"	39.4
Nueces	Riverside, E.	Newman Bros. Drlg. Co. & Alaska Steamship Co's P. N. Wiggins et al 1, J. V. L. & J. de Herrera Sur.	11-20-50	7055	4952- 4968	Frio sd; Olig.	F 111; $\frac{1}{4}$"	30
San Patricio	Welder-Durham	Seaboard Oil Co's R. H. Welder 2, Eliza S. Welder Subd.	11-12-50	7222	4639- 4644	Greta sd; Olig.	F 174; $\frac{5}{32}$"	23
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Field						
Nueces		Eastern States Pet. Co's Adolph Till et ux 1, F. Z. Bishop Subd. 1¾ mi nw Bishop fld.	11-20-50	7815	7241- 7250		F 280; 14 mln; open	58.1
		TEXAS—District 6 (NORTHEAST)—New Oil Field						
Anderson		Texas Co's M. T. Holmes 1, Francis Betick Sur. 2½ mi ne Tennessee Colony fld.	11-17-50	10090	9611- 9642	Pettit li; L. Cre.	F 234; $\frac{3}{8}$"	53.4
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Field						
Runnels		A. J. Renn Trs' D. O. Kennedy 1, J. H. Wilson Sur. 144. 7 mi ne Ballinger	11-2-50	2318	2314- 2318	Serratt sd; Penn.	P 123	39
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Pay						
Tom Green	Pulliam	Sun Oil Co's Lunthicum 4, Sect. 1, AB&M Sur.	11- 9-50	5490	5144- 5160	Palo Pinto li; Penn.	F 127; $\frac{3}{4}$"	37.9
		TEXAS—District 7-C (WEST CENTRAL)—New Gas Field						
Crockett		J. Ralph Stewart et al's Shannon-Phillips 1, Tr. 8, Archer CSL Sur. 2 mi s Noelke fld.	11- 7-50	1895	1798- 1895		F 6 mln.	
		TEXAS—District 8 (WEST)—New Oil Fields						
Andrews		Texas Co's J. D. Biles 1, Sect. 15, PSL Sur. 3 mi w Union fld.	11- 3-50	7573	7390- 7573	Wichita Albany sd; Perm.	F 330; $\frac{3}{4}$"	37.2
Crane		Atlantic Refg. Co's Univ. LL-1, Sect. 6, Blk. 31, Univ. Ld. Sur. 2½ mi w Waddell fld.	11-25-50	11915	11470-11510	Connell sd; Ord.	F 262; $\frac{1}{2}$"	46.3
Dawson		Standard of Texas' Mrs. M. V. A. Smith 1, Sect. 34, Blk. C-41, PSL Sur. 4 mi sw O'Donnell.	11-30-50	9685	7940- 7983	L. Spraberry sd; Perm.	F 73; $\frac{3}{8}$"	37.6
Ector		J. K. Dobb's E. F. Cowden 1, Sect. 6, Blk. 43, T&P Sur. 1¾ mi se Donnelly fld.	10-19-50	4252	3902- 4252	Grayburg li; Perm.	P 92	33
Glasscock		Hubbard S. Russell's Wrage-Hendrickson 1-20, Sect. 20, Blk. 36, T&P Sur. 3 mi e Tex-Harvey fld.	11-12-50	7175	6906- 7175	Spraberry sd; Perm	F 184; $\frac{8}{8}$"	38.3
Hockley		Humble's J. J. Holgood 1, Lab. 10, Lge. 693, State Capitol Lds. Sur. 8 mi ne Yellowhouse fld.	10-20-50	10179	6665- 6675	L. Clear Fork li; Perm.	P 130; 120 wtr	24.4
King		Humble's Bateman Tr. Est. 69, Sect. 133, Blk. A, J. B. Rector Sur. Betwn Ross & Bateman flds.	11-29-50	5324	5310- 5320	Strawn li; Penn.	F 136; $\frac{8}{64}$"	37.5
Midland		Humble's T. O. Midkiff Est. 1, Sect. 46, Blk. 38, T-4-S, T&P Sur. 10 mi s Tex-Harvey fld.	11- 1-50	7520	7304- 7414	Spraberry sd; Perm.	P 80; 5 wtr	33
Pecos		P. L. Crandell's Iowa Realty Tr. 1, Sect. 9, Blk. 10, H&GN Sur. 4 mi w Pecos-HG fld.	11-23-50	1113	940- 1113		P 16.7	27.8
Scurry		Delta Gulf Drlg. Co. & Delta Drlg. Co's H. H. Eiland 1, Sect. 283, H&TC Sur. 5 mi nw Diamond-M fld.	11- 3-50	8230	8182- 8190	Ellenburger dolo; Ord.	P 87	41
		TEXAS—District 8 (WEST)—New Oil Pays						
Lynn	O'Donnell	Humble's W. C. Dulin et al 1, Sect. 431, Blk. 9, ELRR Sur.	10-14-50	9385	9020- 9080	Mississippian li; Miss.	P 135	33.9
Pecos	Abell-Sil-Montoya	C. H. Murphy Corp's Ben Dansby 2, Sect. 28, Blk. 9, H&GN Sur.	11-12-50	5000	2418- 2433	San Andres li; Perm.	F 205; $\frac{8}{8}$"	32
Pecos	Heiner, N.	Curtis B. Inman's Unsicker 1, Sect. 15, Blk. 10, H&GN Sur.	11- 8-50	1495	1320- 1323	Yates sd; Perm.	F 52; $\frac{3}{4}$"	35
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Kent	Salt Creek	General Crude Oil et al's R. D. Coleman 2, Sect. 194, Blk. G, W&NW Sur. ½ mi ne extension.	11-10-50	6533	6190- 6533	Canyon Reef li; Penn.	F 541; $\frac{3}{4}$"	39.7
Kent	Spires	General American Oil Co's R. L. Spires 1, Sect. 10, Blk. 4, H&GN Sur. 1½ mi nw extension.	11-20-50	7227	6880- 6903	Strawn sd; Penn.	P 149	36.7

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovivian; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

Fluid Drives For Drilling Rigs

By KENNETH N. MILLS
Product Manager, Oil Field Sales
International Derrick & Equipment Company, Columbus, Ohio

CONSIDERATION of the fluid drive and its running mate, the hydraulic coupling, for drilling-rig applications involves the evaluation of probable maximum torque multiplication required and high speed demand of the job. The author discusses this adjunct to drawworks and mud pump drive and outlines basic requirements for each type of service.

AS FLUID drives help reduce the amount of physical effort required to operate a drilling rig and help increase its ability to do work, it is reasonable to foresee their expanded use on drilling rigs. The same characteristics which help reduce physical effort help protect the rig from engine vibrations, severe shock load and the engines from overloads.

Fluid drives fall into two general classifications: the positive displacement or hydrostatic drive which uses fluid pressure to transmit power, and the hydrokinetic drive which uses fluid velocity to transmit power. The positive displacement type of fluid drive using pumps and fluid motors has found only limited application in drilling equipment. Due to its high degree of flexibility, the hydrokinetic drive is finding an ever-increasing field of application in oil well drilling equipment.

Two types of hydrokinetic fluid drives are currently used on oil well drilling rigs. These drives are the hydraulic coupling and the torque converter. Each of these devices uses fluid to transmit power. The power is transmitted by storing up kinetic energy in the fluid by increasing its velocity and removing this energy from the fluid by decreasing its velocity. The mechanical characteristics of the two devices are quite different, and the torque converter is available with a wide range of characteristics.

The simplest form of the hydrokinetic drive is the plain fluid coupling, shown in the schematic diagram, Figure 1. In this diagram it will be noted that it consists of two principal parts, the impeller and the runner. For reasons of hydraulic efficiency these two parts form a torus when assembled together. Both the impeller and the runner are fitted with plain, radial vanes. In the case of an actual coupling the runner and impeller are enclosed in a housing which is filled to about 90 percent of its volumetric capacity with fluid. The unfilled space acts as a reservoir for the fluid volume increase resulting from fluid expansion which may occur in operation.

When power is introduced to the impeller the fluid contained in its pockets is forced to rotate with the impeller. As the fluid is rotating it is subjected to centrifugal force causing it to flow towards the outer edge of the impeller. At the beginning of rotation the runner is stationary; therefore, the fluid in the runner is not subjected to centrifugal force at this instant. Consequently, the fluid in the impeller enters the runner near its outer edge and forces the fluid from the runner into the impeller near its inner edge. In this manner fluid circulation is set up and the circulation will continue as long as there is a difference between the speeds of the impeller and the runner. In the normal operation of the fluid coupling the speed of the runner is always less than that of the impeller and the centrifugal force in the impeller is always greater. This difference in the centrifugal force in the two halves causes the fluid to circulate in the torus.

As the fluid is circulating around the torus, and the torus is rotating, the fluid in the coupling has a dual motion. As a result of each of these motions, it carries a certain amount of kinetic energy. Since the area of the flow path is constant there is no change in velocity in the vortex motion. However, the absolute velocity in the path around the coupling increases as the liquid passes from the inlet to the outlet of the impeller and decreases as the fluid flows from the inlet to the outlet of the runner. Since the velocity of the fluid increases in the impeller it gains kinetic energy in the impeller and loses kinetic energy in the runner. Thus the power delivered by the runner represents the loss of kinetic energy by the fluid in the runner, and the power is not transmitted by shearing the liquid between the impeller and the runner.

Hydraulic couplings are available in two basic constructions. One type of coupling is filled with a constant volume of oil. A sectional view of a coupling of this type is shown in Figure 2. The design of the other coupling is such that either the amount of fluid in the circuit can be varied or a limited amount of the fluid can be continuously removed from the circuit for cooling. A sectional view of a coupling of this type is shown in Figure 3. As the fluid in the latter type of coupling can be cooled it can be operated at a higher rate of slip than the constant fill type coupling. The variable fill type coupling has been applied to drilling rigs.

The basic characteristics of all types of fluid couplings are identical. All are capable of transmitting torque

but they will not multiply torque. The output torque of a fluid coupling is invariably equal to the input torque less the coupling losses. A typical performance curve for an engine driven fluid coupling is shown in Figure 4. On this performance curve it will be noted that the characteristics of the fluid coupling allow the engine to start at practically no load and accelerate to a rather high torque capacity before the coupling starts to deliver power. This is an advantage in applications involving the acceleration of a dead load, because the engine is not called on to deliver full torque at low engine speeds, and consequently the average rate of load acceleration is higher when the fluid coupling is used. As the load is transmitted through fluid the fluid coupling will protect the driven unit from engine vibrations.

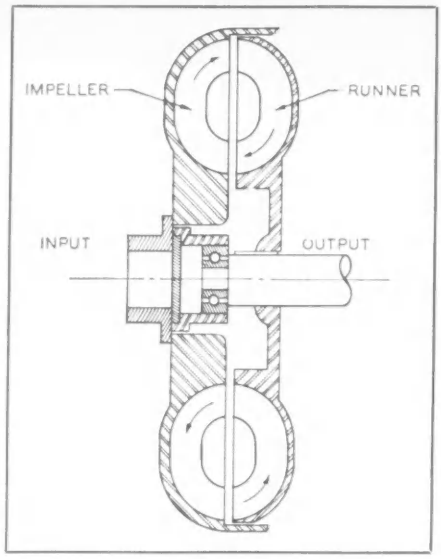

FIGURE 1.

Whereas the fluid coupling is in reality a clutch, the torque converter is both a clutch and a fully automatic transmission. A schematic diagram of a torque converter is shown in Figure 6. In this diagram it will be noted that it consists of an impeller or pump, a runner or turbine and a reaction member. The reaction member is fixed and is located between the runner and impeller. In a practical torque converter these members are fitted with streamlined blades or vanes instead of plain radial vanes as in the case of the coupling, and the blades are set at an angle to the axis of rotation of the converter. The design of the blading and addition of the reaction blading increases the ability of the runner to absorb kinetic energy from the fluid. This increase in energy absorption accounts for the torque multiplying ability of the torque converter. Actually the torque converter consists of a centrifugal pump (the impeller) and a compact turbine which is connected to the output shaft. Converters may consist of any multiple number of turbine stages, each consisting of a set of stationary reaction blades and a set of turbine or runner blades connected to the output shaft. The operating principle of the converter is illustrated diagrammatically in Figure 6. The operating characteristics of the converter will depend on the number of stages and the mounting of the reaction blades. As will be shown later when the reaction blading is mounted on an over-riding (one way) clutch, it assumes some of the characteristics of a fluid coupling when the output torque equals the input torque.

As the performance characteristics of the torque converter are ideally suited to hoisting, its first oil field applications were found in oil well servicing hoists. Due to the high degree of flexibility afforded by the torque converter, it is finding increasing application on complete drilling rigs and is used to provide hoisting, rotating and mud circulating power. The use of either the fluid coupling or the torque converter make the full power of the engine instantaneously available for accelerating the load. The comparative accelerating forces for hoists equipped with friction clutches, fluid couplings and torque converters are shown in Figure 7. When a drilling rig equipped with a friction clutch is used to hoist it is customary to open the engine throttle and engage the friction clutch simultaneously. During the initial portion of this operation the friction clutch is slipping and the engine is accelerating. When the clutch is slipping, power is being lost. However, if this power loss did not exist the engine would not have sufficient power due to its low speed to accelerate and start the load. As a result of this condition it would stall. After the clutch is fully engaged the engine is operated at a speed below its peak torque speed, and it must labor or work up to its peak torque speed. As a consequence

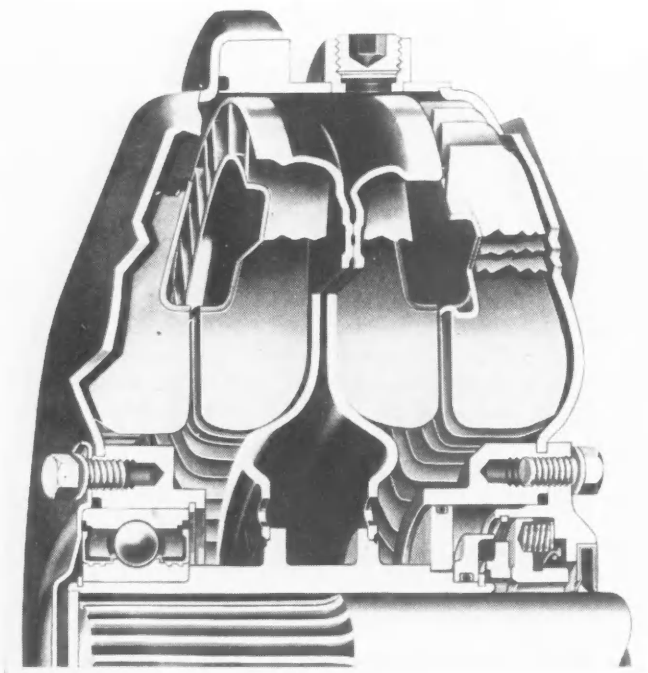

FIGURE 2.

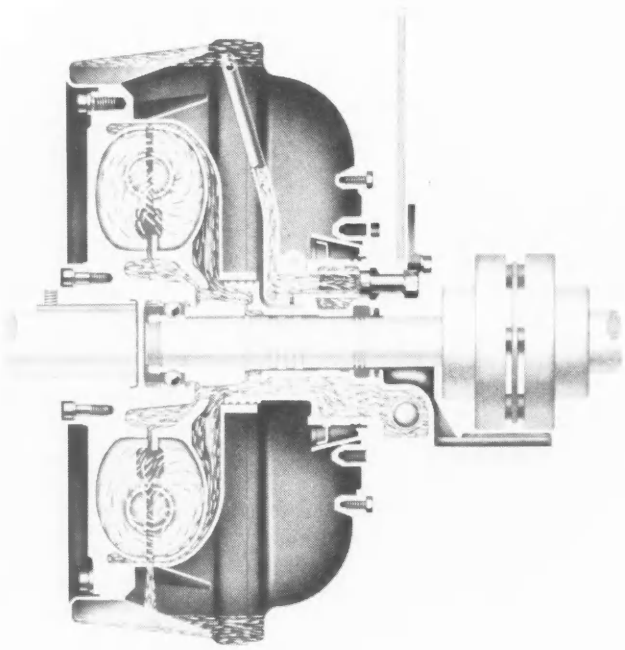

FIGURE 3.

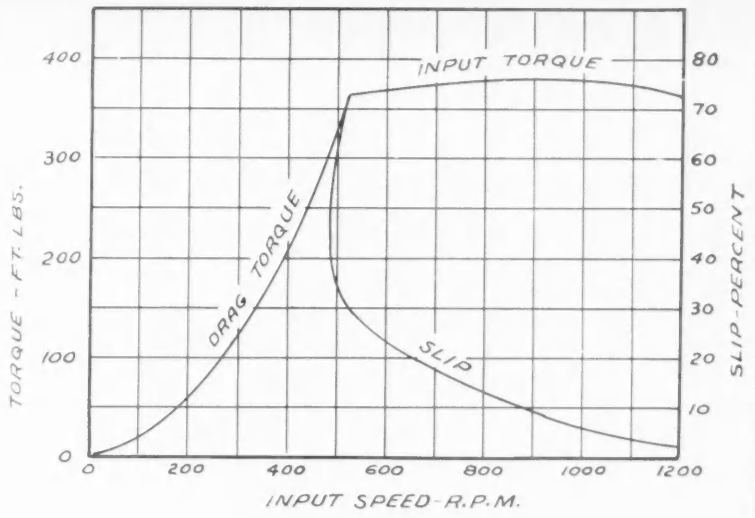

FIGURE 4.

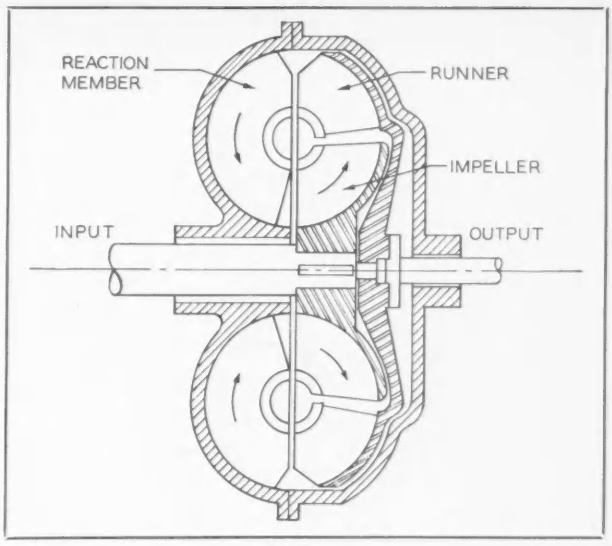

FIGURE 5.

of these two conditions the full power of the engine cannot be used to hoist the pipe, because the hoisting load is determined by the magnitude of the load which can be lifted off the slips. This accounts for the theoretical friction clutch curve in Figure 7 starting near zero. The true starting point of this curve will depend on the magnitude of the clutch slip and engine characteristics and the skill of the driller.

Peak Engine Torque

When a drilling rig is equipped with fluid couplings, the peak engine torque is available for starting the load. In this case the operator opens the throttle and the engine is accelerated to its peak torque point. Due to the characteristics of the fluid coupling this acceleration is very rapid and the full engine peak torque is rapidly available to start the load. Thus the full engine power decreased by the small losses in the coupling is available to lift the load.

When a drilling rig is equipped with a torque converter, a torque greater than the peak engine torque is available for starting the load. As in the case of the fluid coupling the operator opens the engine throttle and the engine accelerates to its peak torque point. This engine acceleration is very rapid and a torque in excess of the engine torque is rapidly available to start the load. As the load starts to move the force required decreases and the line speed increases. Thus when the maximum effort is required it is available and as the portion of the line pull required to accelerate the load decreases the rate at which the load is moved increases. In this manner all of the available power is devoted to lifting the load and power losses due to clutch slipping are eliminated.

A typical performance curve for a torque converter driven hoist is shown in Figure 8. In this case the hoist has two speed ratios between the torque converter and the hoist drum. For purposes of comparison the line pull available from the full engine horsepower and the theoretical performance of a friction clutch driven hoist are shown. When attempting to compare the friction clutch hoist with the torque converter driven hoist, it must be remembered that due to clutch slippage and engine characteristics the friction clutch performance can not be achieved. The performance shown for a friction clutch hoist could be approached with a fluid coupling driven hoist. When it is recognized that the maximum line speed on a friction clutch hoist in a given gear (transmission speed) ratio is limited by the engine governor and it must remain in this gear until it is capable of moving the load in a higher gear, it is reasonable to expect higher hoisting speeds on a torque converter driven hoist. This characteristic is produced by the automatic action of the torque converter which produces an increase in hoisting speed as the load decreases. If the operator does not shift the friction clutch rig to a higher gear at the proper time, the advantage of the torque converter driven hoist is increased. This has been verified by field tests made with comparable hoists.

The basic characteristics of the torque converter protect the engine from overloads. As the torque converter is designed to absorb the full engine horsepower at full governed speed, the engine cannot be overloaded. The output shaft of the converter merely seeks a speed which corresponds to the load imposed on it. The power absorption characteristics of the converter are such that the engine can be accelerated to its governed speed almost instantaneously, and consequently the engine is

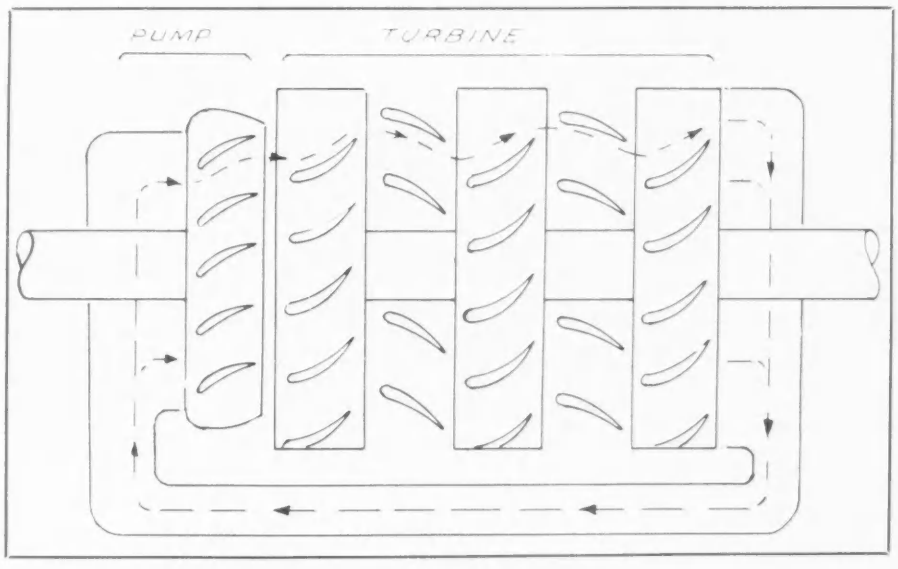

FIGURE 6.

not called on to operate at low manifold pressure or under lugging conditions. Studies of engine performance on conventional hoists indicate that the engines on these hoists are operated under lugging conditions over an extensive portion of the hoisting cycle. When it is realized that the engine on a friction clutch hoist must accelerate under load, this is the result which should be expected.

When the slush pump is driven with a torque converter its performance characteristics are changed and it assumes some of the characteristics of a direct-acting steam pump. These characteristics result from the fact that the rotating speed of the pump varies with the discharge pressure after the pressure has increased to some predetermined value. This speed variation does not exist over the full range of pressure variations because the maximum speed of the pump must be limited to assure freedom from fluid pound.

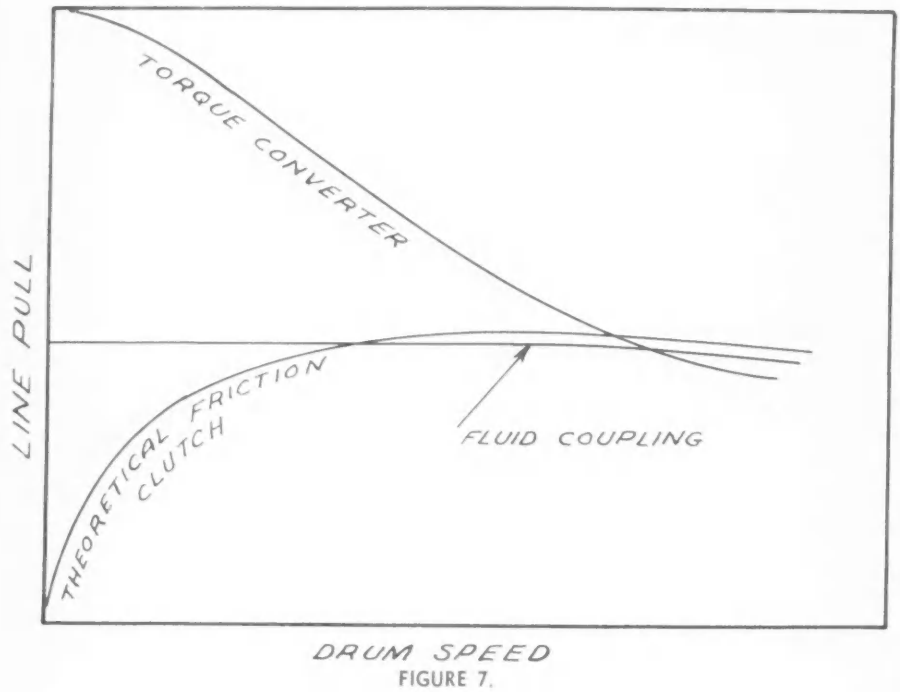

FIGURE 7.

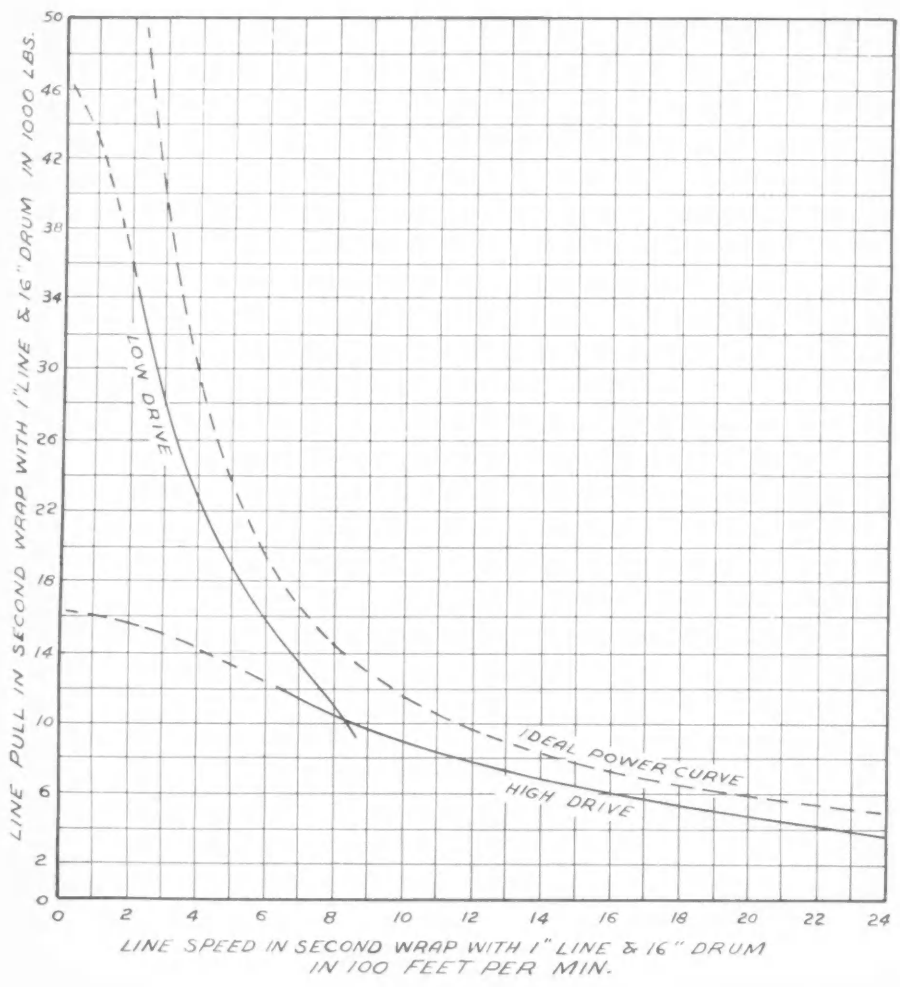

FIGURE 8.

Due to the maximum torque multiplication available with torque converters it is theoretically possible to seriously overload a slush pump with a torque converter. However, when the drive ratio between the pump and the torque converter is properly selected, the magnitude of this possible overload is materially reduced. The drive ratio should be selected to produce the maximum pump speed when the torque converter is delivering maximum horsepower at its output shaft. Under these conditions the maximum torque multiplication from any type torque converter is about 3 times instead of 5, and this torque will be exerted only under stalled conditions at full engine throttle.

When evaluating the possible adverse effects of torque converters on slush pumps, their basic rating system must be evaluated. All slush pumps ratings are based on a constant maximum piston rod load or pressure, and this rating does not increase as the pump speed is decreased. Theoretically this rating basis may not be exactly correct as the load capacities of the bearings and gears vary with speed and these capacities increase as the speed is decreased. Considering the load capacities of the bearings and gears only, the load capacity of one make of slush pump would vary with speed as shown in Figure 9. This basic characteristic of these elements is favorable to the torque converter driven pump, as the pump speed will decrease when the pressure increases. Naturally, the practice of exceeding the rated piston rod load capacity of a pump at low speeds may overstress some of the other elements of the pump if carried to an extreme. Overloads of this nature could cause a material reduction in the life of these parts.

When evaluating the torque converter as a power source for a slush pump, the nature of the connected load must be considered, if an accurate evaluation is to be obtained. In the case of the slush pump the connected load is the down-the-hole circulating system, and consists of the

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pressure losses inside the drill pipe, in the bit wash-pipe and in the annulus. If it is assumed the rate of circulation remains constant, the pressure required to circulate the drilling mud will increase directly with depth. For a given depth, the pressure required to circulate the drilling mud will vary approximately with the square of the rate of circulation and it will increase as the rate of circulation is increased. As one of the prime purposes of the drilling mud is to transport the cuttings from the bit to the surface, when a given hole is considered a constant rate of circulation is desirable; therefore, in an analysis of pump performance it would be reasonable to assume a constant pump speed.

If it is assumed that a constant size hole is drilled the circulating pressure should increase gradually as the depth increases until a depth is reached which will create a circulating pressure corresponding to the maximum pressure rating of the pump. When this condition arrives on a mechanically driven slush pump the liners in the pump must be changed to reduce the rate of circulation which will reduce the circulating pressure and the load on the pump. If the pump is driven with a hydraulic torque converter the pump will automatically slow down as the pressure increases beyond this point. This automatic decrease in pump speed will cause the rate of pressure increase to decrease and will permit drilling to a materially greater depth before a liner change is required.

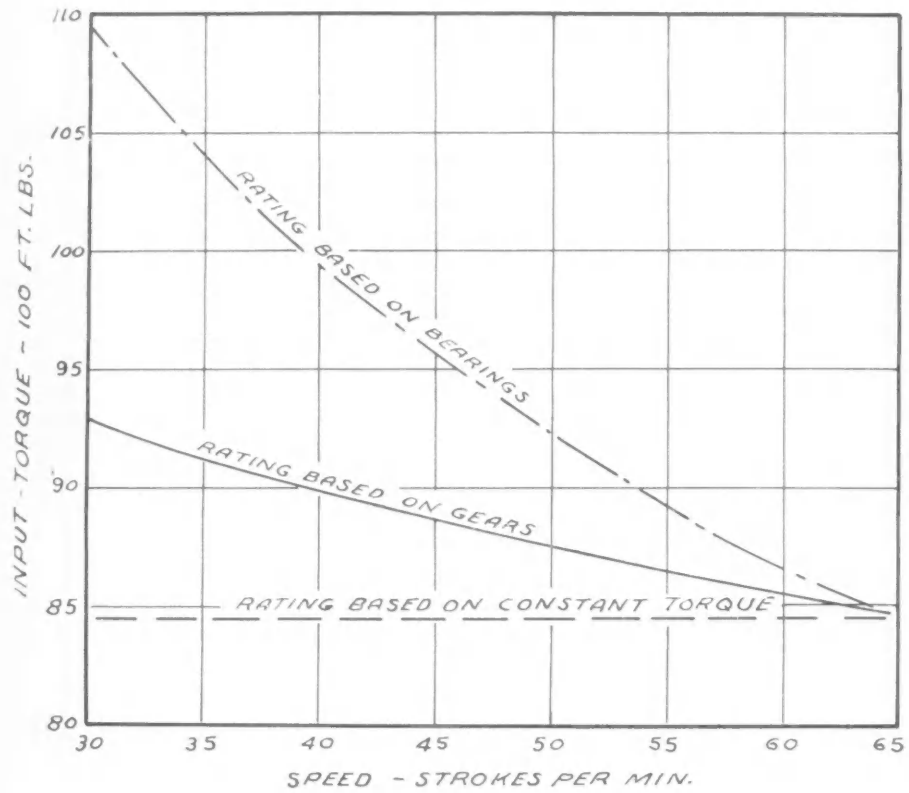

FIGURE 9.

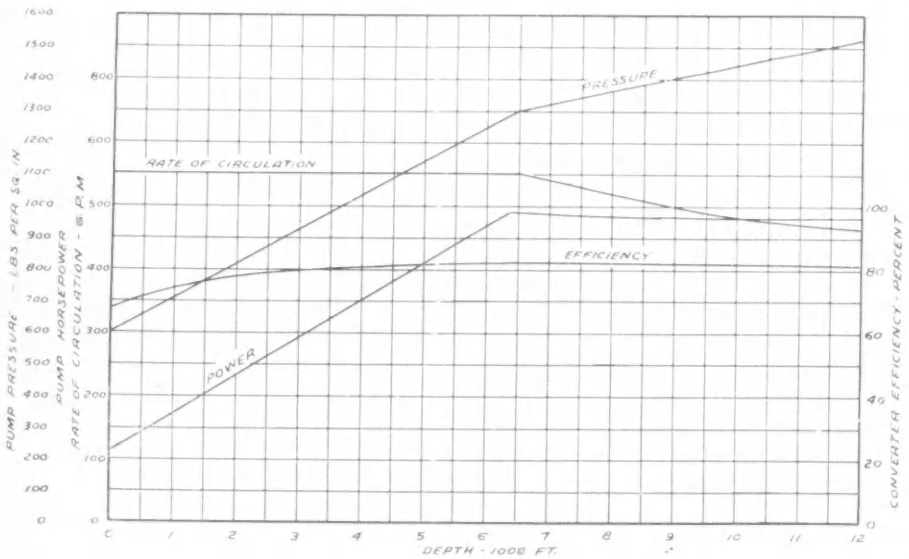

FIGURE 10.

This action can be illustrated by plotting pump performance against depth for an assumed well. A performance curve of this type is shown in Figure 10. This curve is based on drilling a 9⅞-inch hole with 4½-inch drill pipe with a maximum input horsepower of 490 and a return velocity in the annulus of 175 feet per minute. On the curve it will be noted that the pressure increases gradually until the engine is delivering its maximum power. When this point is reached the rate of circulation starts to decrease, the rate of pressure increase decreases, and the engine delivers practically a constant amount of power. Also, it will be noted that the converter efficiency remains high over the entire range.

If a mechanical drive had been considered in the above analysis a liner change would have been required at approximately 6500 feet. This liner change would have reduced the rate of circulation at that point. It has been shown that in soft formation drilling the rate of penetration varies directly with the rate of circulation and decreases as the rate of circulation decreases. Therefore, when a mechanical pump drive is considered, the rate of drilling penetration after 6500 feet would be less than that obtained with a torque converter driven pump. This advantage will exist until the rate of circulation obtained with the torque converter driven pump decreases to a rate equal to that of the mechanically driven pump with reduced liners. In addition to increasing the rate of penetration this increased circulating rate gives added protection against stuck drill pipe because of increased ability for carrying cuttings.

In addition to improving the operating characteristics of the slush pump the torque converter cushions the load on the compounding transmission and the V-belt drive to the pump. This shock absorbing action increases the life of these driving elements. Also it protects the engine from overloads resulting from attempting to "get by" without changing liners. This will decrease engine and slush pump maintenance costs.

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EFFECT OF

Mud Pump Surges

By HENRY CHARLES WACHTMAN, JR.

Field Engineer, Oil and Gas Division,
Osage Indian Agency, Pawhuska, Okla.

THE EFFECT of surges on the carrying capacity of drilling fluids has been discussed as to whether or not the surges should be eliminated. Laboratory tests were made by injecting cuttings into a test bore and measuring the net rise velocity of the cuttings for a distance of travel of three feet. The slip velocity was then calculated and plotted to see if surges were detrimental or helpful. By keeping all physical properties constant, the effect of surging was noted by first running a test without surge and then rerunning the same test by using a pulsator to create surge in the fluid column. The tests show that when surges are present the slip velocities of the cuttings are increased, and that surge elimination is important. This article was prepared for WORLD OIL from a talk presented at a joint meeting of Mid-Continent Local Section, Tulsa, Oklahoma Local Section, AIME, at University of Tulsa, Tulsa.

MUD pumps in common use are of the positive displacement type, most frequently the double-acting duplex piston pump. Distinct surges created by this pump are transmitted through the piping, flexible hose, drill stem and some distance up the hole from the bit. The distance up the hole through which these surges may be felt will depend upon the condition of the mud and the formations in the earth. In order to study the lifting and carrying ability of these fluids, laboratory tests were run to see if the surge effect from the mud pumps was helpful or detrimental in the removal of these cuttings. If surges can be proven to be beneficial or detrimental for the removal of these cuttings, as far as the carrying capacity of the mud is concerned, then the drillers or drilling companies will have additional facts and be better able to determine the advisability of removing the surge from the mud pumps. The rate at which drilling fluids can remove cuttings from the bit and well bore may be a major factor in determining drilling rate and thus the cost of the well.

Since the drilling cost is the major expense of drilling a well, and amounts to several hundred dollars per day, anything that will increase the drilling rate will reduce the drilling cost.

Previous Investigations

No literature can be found on the effect of surges on drilling muds, but there is good material available on the flow properties and lifting ability. Some of these are listed in the bibliography.

Drilling muds are not true fluids, but instead are plastic materials which obey the laws of plastic flow. A quantitative expression of plastic flow was developed by E. C. Bingham[2] in 1920. Bingham found his equation applicable and useful to the industries dealing with ceramics, paints, sewage disposal and soil physics, but Evans and Reid[3] of Burmah Oil Company, Ltd., comprehended the importance of mud flow properties in applying his equation to certain drilling mud problems.

More early reliable work was done by W. B. Gregory.[6] Gregory experimented with clay slurries and found that the pressure remained practically constant at all velocities up to the critical, where the flow breaks over from viscous to turbulent. Another important fact that Gregory found was that after turbulence has been attained, the muds behave as true liquids, and in spite of the relatively high percentage of solids, the turbulent region viscosity is surprisingly low (a little higher than water). Information along similar lines was obtained by Ambrose and Loomis.[1]

Information concerning the ability of drilling muds to lift bit cuttings has been reported by Hall, Thompson and Nuss,[7] Pigott[9] and others. Pigott concluded that the rising velocity and density is most useful for lifting, and that high viscosity either in viscous or turbulent regions is undesirable, as it raises pump pressure in all cases, and in viscous regions is a serious obstacle to dropping cuttings. Hall concluded that from his experimental data, empirical equations can be derived that show slip velocity is dependent on cutting size and shape, mud flow constants, and flow state of the mud.

Rouse,[10] Wadell[11] and many others have shown that there is a definite correlation between the coefficient of drag that a particle has in a fluid and the Reynolds number, and that this relationship is different for different shapes of particles. Wadell has shown that slip velocities of various flat particles require different coefficients of drag vs. Reynolds numbers, these relationships being dependent on relative flatness of the particles (Figure 1).

Dawson and Kalinske[4] have found that when a surge wave is created, the

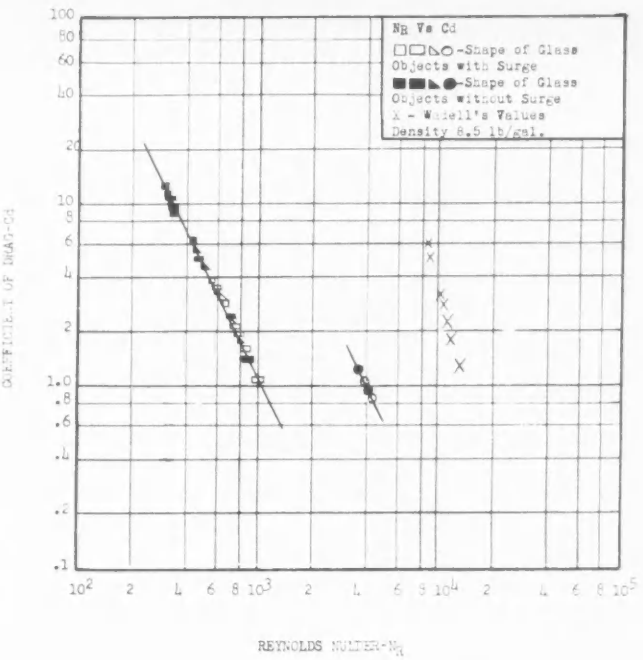

FIGURE 1.

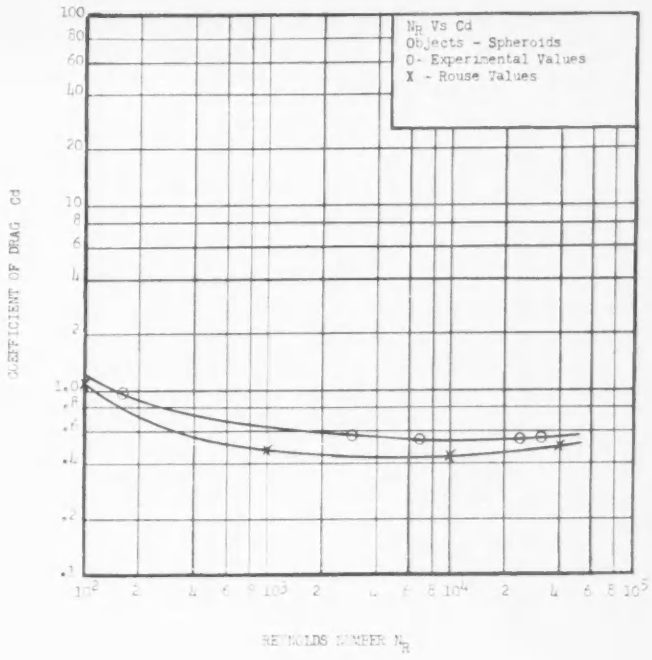

FIGURE 2.

wave travels at a much higher rate than the mud. The velocity of the wave that the surge makes travels at a rate equal to

$$4700\sqrt{\frac{1}{\frac{1+KD}{Et}}} \text{ or } \sqrt{\frac{12}{\frac{w}{g}\left(\frac{1}{k}+\frac{D}{SE}\right)}}$$

feet per second where:

K = modulus of elasticity of the fluid, pounds per square inch.
E = modulus of elasticity of the pipe, pounds per square inch.
D = diameter of the pipe, feet.
t = thickness of the pipe, feet.
S = stress, pounds per square inch.
w = weight of the fluid in pounds per cubic foot.
g = acceleration of gravity, 32.2 feet per second.

Therefore, the velocity at which surges are traveling in drilling muds is around 4000 feet per second.

Statement of Problem

The object of this experiment was to show the effect of surges on the carrying capacity of drilling fluids and was undertaken primarily to obtain information of a fundamental nature to see if it would be advisable to eliminate the surge when drilling a well.

There are many variable factors involved in the effect of surge on the carrying capacity of drilling muds. It was thought best to vary only one factor at a time and as far as possible to keep all other factors constant.

The variable factors studied in this investigation:

- The weight and shape of the particles.
- The velocity and viscosity of the mud.
- The amplitude and frequency of the surges.

To determine the slip velocity of the particles both with and without surge, equipment was built so that cuttings could be injected into the mud stream at the lower end of the pipe representing the drilling well.

A plastic two-inch inside diameter tube four feet long was used to represent the well bore so that cuttings in the drilling mud could be observed as they were being carried upward to the reservoir. Rubber bands were placed around the plastic pipe to mark a three-foot distance on the pipe, so that the time of travel for a definite distance could be measured. The plastic pipe was connected to the rest of the piping by using regular 2¼-inch inside diameter automobile radiator hose.

Two 50-gallon per minute centrifugal pumps, driven by electric and gasoline motors, were used to pump the drilling mud. Flow rates were varied by a throttling valve with the electric pump apparatus and the rates were varied by the engine throttle when using the gasoline engine.

To apply the surge to the drilling mud, a pulsator driven by an electric motor was used. The pulsator can be varied from 180 to 2700 cycles per minute to see if the frequency of the surge has any effect on the lifting ability of the mud. The pulsator unit and a balloon connected to the one-half inch surge line were filled with glycerin. This balloon was inside of another two-inch I.D. plastic pipe connected to the other side of the tee at the bottom of the mud column. The plastic pipe was used so that the balloon could be observed while surging, to be sure that no air bubbles were trapped in the pulsator unit. This arrangement provided for any constant and reproducible surge.

After trying several methods to inject cuttings into the well bore, a piston injector was built using a three-fourth inch smooth bore tee so that a water-tight piston could be used to inject the cuttings into the well bore. A gate valve on top of the tee made possible cutting injection without interrupting the mud flow.

A galvanized iron reservoir tank was built to hold about ten gallons to provide an excess volume of mud for the system and also afford a place where cuttings could be retrieved and kept from recirculating. The tank was painted with a clear plastic paint so that the galvanized finish would not tarnish and change the color of the drilling mud. It was also necessary to have a removable measuring tank so that the quantity of flow from the well bore into the reservoir tank could be measured both before and after each set of cuttings was injected, so as to insure constant velocity for the test being made.

A viscosimeter and mud balance were used, so that the viscosity and density could be measured and kept

constant for each run. Mud mixing was simplified by the use of a mixer and the viscosity and density of the mud was easily changed by mixing a thicker mud and adding to the reservoir.

Materials Employed

The drilling fluids used in this experiment were water and gel mixtures or bentonite. The bentonitic material used was a pure clear rock bentonite from California. This bentonite was used to keep the fluid as clear as possible so that the velocity of the cuttings could be observed in the plastic pipe as they were injected into the fluid stream. The bentonite chunks were placed in a water bath for 24 hours so they would dissolve and make a gel solution. With the bentonite in the gel state, all impurities of dark color were removed and the pure gel bentonite was kept in clear water until used.

A commercial gel was used on only one test, because the mud was so dark that only the large sphere cuttings could be observed in the plastic pipe. It is felt that all drilling muds will behave substantially the same as the bentonite suspension used for most of the experimental work.

Glass cuttings were used in this experiment because their densities are in close range to the densities of the rock encountered while drilling. Other particles were used to determine any general trends and extend the curves over a wider range of values.

The glass was cut and ground on an emery wheel to the exact size and shape, so that 15 cuttings of each type were available for testing. Spherical particles were obtained by using different size marble, beads and lead shot. Ottawa sand, which is made up of small spheroids of quartz, was also used.

The various sizes and shapes of particles (see Table 1) were measured by using an outside micrometer.

Procedure

The reservoir tank and well bore were filled with water at a known temperature.

With no circuation, cuttings were dropped from the reservoir tank into the well bore in order to measure the time required for a cutting to fall a distance of three feet when the water velocity is zero. This procedure was followed until data for eight cuttings of each shape and size were recorded. The same tests were run again, only this time the pulsator was run to give the surge effect to the water.

The surge generator built for this experiment provided a surge of 0.147 cubic inches at frequencies ranging from 3 to 45 cycles per second. By observation of four actual drilling operations, it was found that the surges from the mud pumps were from 4 to 12 cycles per second depending upon the type and speed of the pump. Throughout these tests, surges were generated at about ten cycles per second. Increases in amplitude and frequency should intensify any effect. The surge generator equipment used was not satisfactory above 20 cycles per second.

The drag against any object acted upon by a fluid stream is known to be:

$$\overline{D} = Cd\ w\ A \frac{V^2}{2G} \qquad \text{(See Rouse.}^{10}\text{)}$$

Where:

$\overline{D}$ is drag force in pounds.

Cd—The coefficient of drag which varies with the roughness, size, shape and slip velocity, dimensionless.

w—weight of the fluid in pounds per cubic foot.

A—the projected area of the object, square feet.

V_s—velocity of the fluid with respect to the object commonly known as the slip velocity, fps.

g—acceleration of gravity, 32.2 feet per second, per second.

In the case of a completely free particle in equilibrium surrounded by a

Data Table 1

Particle No.	Particle	Dimension	Density	Wt. Lbs.	Wt. of Part in Fluid-Lbs.
1	Glass Sphere	D=.132"	162 lb/ft.^{3}	1.14×10^{-4}	7.01×10^{-5}
2	Glass Sphere	D=.22"	162 lb/ft.^{3}	5.18×10^{-4}	3.18×10^{-4}
3	Ottawa Sand	D=.0220"	165 lb/ft.^{3}	2.27×10^{-7}	1.42×10^{-7}
4	Lead Shot	D=.1056"	708 lb/ft.^{3}	2.47×10^{-4}	2.20×10^{-4}
5	Glass Sphere	D=.62"	162 lb/ft.^{3}	1.11×10^{-2}	6.82×10^{-3}
6	Glass Rectangle	.502x.265x.084	162 lb/ft.^{3}	1.01×10^{-3}	6.21×10^{-4}
7	Glass Rectangle	.314x.264x.084	162 lb/ft.^{3}	6.19×10^{-4}	3.81×10^{-4}
8	Glass Triangle	.40x.30x.084	162 lb/ft.^{3}	4.72×10^{-4}	2.90×10^{-4}

Fluid H_2O: Weight=62.4 lb/ft.^{3}, T=67 to 70 F.

Part No.	Ave. Flow Sec./ Gal.	Vel. Mud fps	Ave. Time of Part. for 3 Ft.	Vel. of Part. fps	Slip Vel. fps	Cd 2 gD / waV$_s$	NR dvw / μ	Viscosity
1	0	0	2.57	1.164	1.164	.554	3,085	2.09×10^{-5}
2	0	0	1.94	1.546	1.546	.526	6,830	"
3	0	0	8.14	.368	.368	.957	166	"
4	0	0	1.12	2.680	2.680	.534	24,870	"
5	0	0	1.18	2.542	2.542	.547	31,700	"
WITH SURGE								
5	2.75	2.23	15.07	.199	2.031	.832	4,220	1.25×10^{-4}
5	2.60	2.35	9.5	.316	2.039	.844	4,400	"
5	2.35	2.61	4.35	.690	1.920	.953	4,140	"
5	2.00	3.06	2.47	1.215	1.847	1.030	3,986	"
5	1.80	3.41	1.90	1.578	1.832	1.010	3,800	"
5	1.60	3.83	1.60	1.875	1.955	.917	4,200	"
6	2.75	2.23	2.09	1.430	.800	2.318	704	"
6	2.60	2.35	1.94	1.547	.808	2.268	712	"
6	2.35	2.61	2.09	1.435	1.175	1.095	984	"
6	2.00	3.06	1.38	2.175	8.875	1.887	781	"
6	1.80	3.41	1.185	2.530	.880	1.914	776	"
6	1.60	3.83	1.016	2.955	.875	1.944	770	"
7	2.75	2.23	1.93	1.554	.676	3.285	598	"
7	2.60	2.35	1.74	1.725	.625	3.830	554	"
7	2.35	2.61	1.61	1.865	.745	2.698	661	"
7	2.00	3.06	1.29	2.325	.737	2.765	653	"
8	2.75	2.23	2.19	1.320	.910	1.840	823	"
8	2.60	2.35	1.96	1.532	.823	2.240	745	"
8	2.35	2.61	1.58	1.898	.712	2.998	644	"
8	2.00	3.06	1.28	2.350	.712	2.998	644	"
WITHOUT SURGE								
5	2.75	2.23	15.03	.1997	2.030	.851	4,377	"
5	2.60	2.35	7.80	.385	1.970	.903	4,255	"
5	2.35	2.61	3.87	.775	1.835	1.040	3,960	"
5	2.00	3.06	2.22	1.364	1.698	1.217	3,665	"
5	1.80	3.41	1.90	1.578	1.832	1.010	3,800	"
5	1.60	3.83	1.707	1.760	2.070	.818	4,470	"
6	2.75	2.23	1.61	1.864	.366	11.08	322	"
6	2.60	2.35	1.54	1.948	.407	8.98	358	"
6	2.35	2.61	1.46	2.055	.555	4.830	488	"
6	2.00	3.06	1.25	2.400	.663	3.388	583	"
6	1.80	3.41	1.158	2.590	.820	2.210	723	"
6	1.60	3.83	1.064	2.855	.975	1.563	858	"
7	2.75	2.23	1.72	1.745	.485	6.370	430	"
7	2.60	2.35	1.51	1.986	.396	11.00	327	"
7	2.35	2.61	1.33	2.255	.345	12.57	306	"
7	2.00	3.06	1.13	2.655	.407	9.07	361	"
8	2.75	2.23	1.80	1.668	.562	4.810	508	"
8	2.60	2.35	1.51	1.986	.369	11.15	334	"
8	2.35	2.61	1.43	2.098	.512	5.820	463	"
8	2.00	3.06	1.00	3.000	.0625	39.00	56.5	"

Fluid Bentonite: Wt.=8.5 lb/gal., vel. of mud=2.61 ft./sec. T=67 to 70 F.

WITH SURGE								
6	2.35	2.61	1.70	1.766	.844	2.090	743	6 cp
6	2.35	2.61	1.95	1.537	1.073	1.310	562	4 cp
6	2.35	2.61	2.09	1.435	1.175	1.095	984	2 cp
WITHOUT SURGE								
6	2.35	2.61	1.46	2.055	.555	4.830	488	6 cp
6	2.35	2.61	1.780	1.685	.925	1.460	484	4 cp
6	2.35	2.61	1.910	1.570	1.040	1.399	872	2 cp

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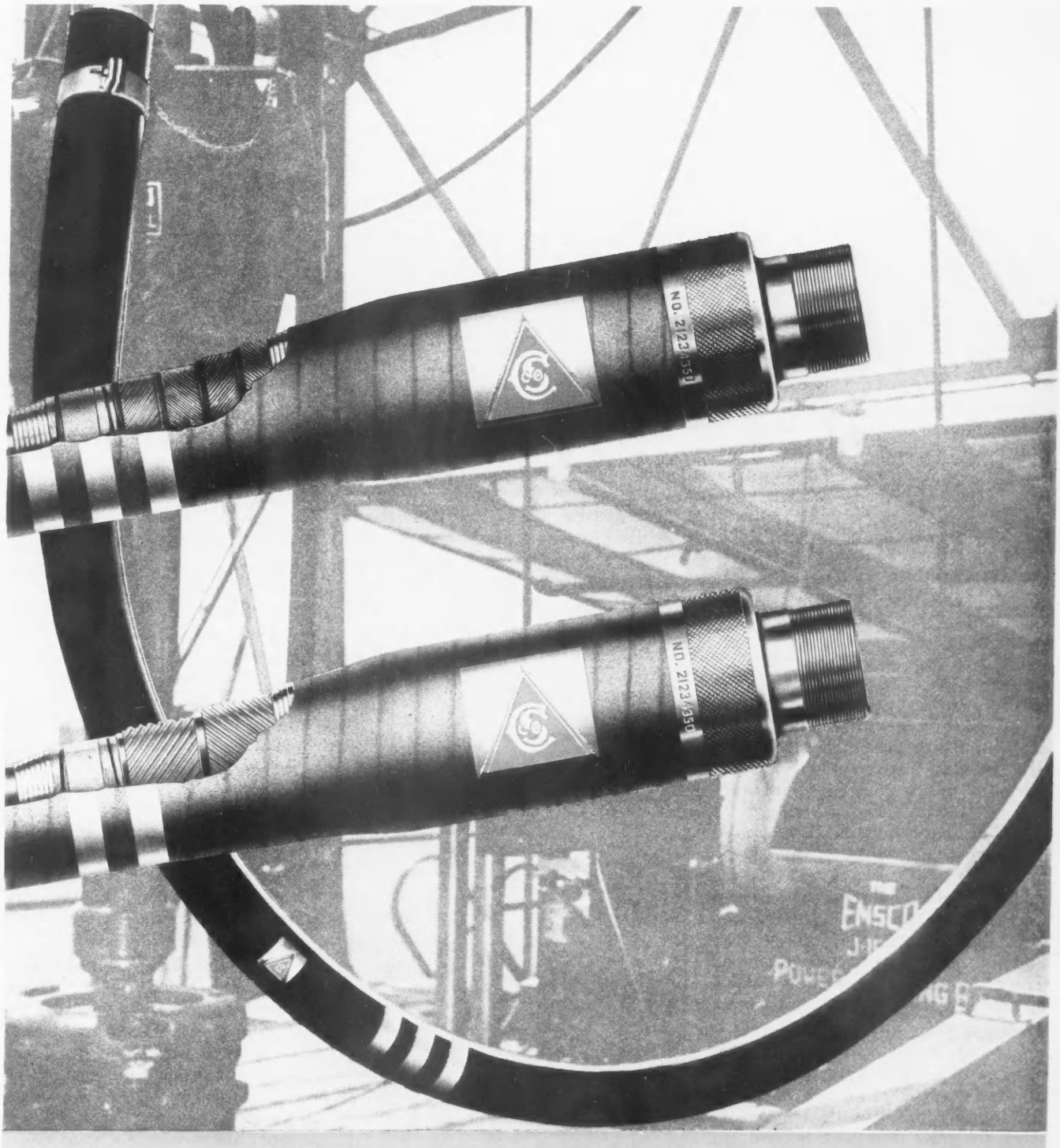

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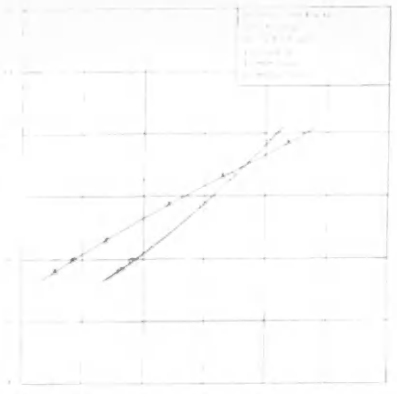

FIGURE 3.

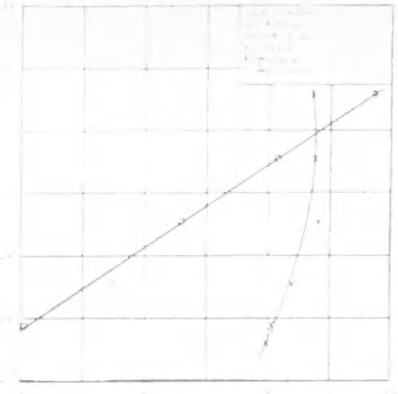

FIGURE 4.

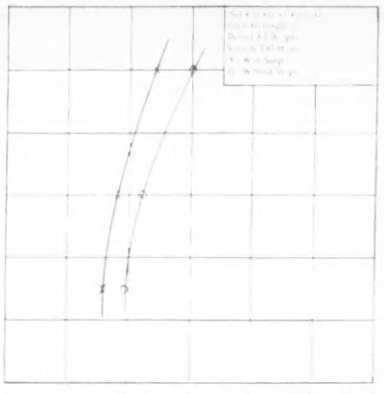

FIGURE 5.

fluid the drag force D will be the effective weight of the particle in the fluid. The coefficient of drag is known to depend upon the size and shape of the object, as well as the viscosity, density and slip velocity of the fluid. These relationships are usually given by means of a plot of Cd versus the Reynolds Number $\frac{DV_s\rho}{\mu}$. From the experimental data, the coefficient of drag and Reynolds Number for each cutting were calculated and plotted (Figure 1) on log log paper to see if the relationship has the same trend as the curves given by Rouse[10] and Wadell.[11]

The next step was to mix bentonite mud with the water already in the reservoir to the desired density and viscosity for the next test. The centrifugal pump was put into operation so that the mud was circulated, keeping the mud under constant conditions. The flow of mud was governed by a throttling valve, and the rate of mud flow was measured by the measuring tank and a stop watch so that the velocity could be computed. Cuttings were injected one at a time by the piston injector, so that the net rise velocity could be accurately timed with a stop watch as they were carried up the well bore from bottom to top.

First step in injecting a cutting is to have the injector piston at the front of the piston cylinder so that the mud flow is cut off from flowing back into the cylinder and out the gate valve when the valve is opened. Second, the cutting is placed in a holding chamber on top of the gate valve and this chamber is then plugged with a cork to insure no leakage when the valve is opened. Third, with the cutting in place the gate valve is opened to allow the cutting to fall down on top of the piston injector. Allowing sufficient time for a cutting to pass through the valve, the valve was closed so that the flow of mud was shut off when the piston injector was brought to the back of the piston cylinder. This allowed the cutting to fall into the piston cylinder for injection. The next step was to inject the cutting into the well bore by pushing the piston forward.

Mud tests were first run on cuttings injected into the mud with a constant density and viscosity and a varying velocity. Tests were also run on a gel mud with the velocity held constant and the viscosity and density varied.

Eight cuttings of each shape and size were injected for each test and their net rise velocity was measured by a stop watch for a distance of three feet of travel up the well bore. These tests were run first without a surge and then with a surge on the mud flow, so that the difference in the net rise velocity could be obtained under otherwise identical conditions. From such data, slip velocities can be calculated and plotted on a graph to show the effect of surges on the carrying capacity of drilling muds.

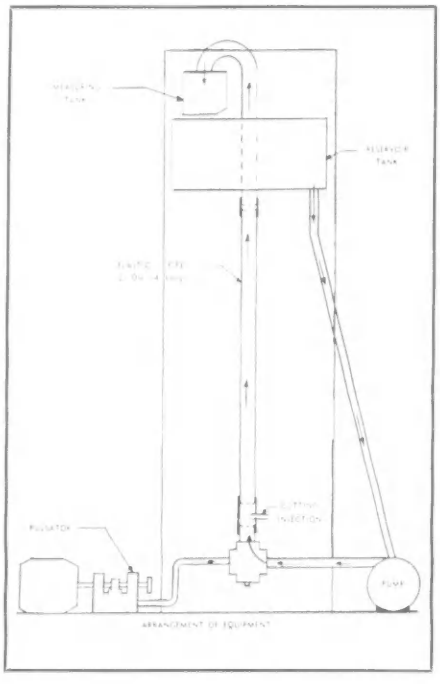

FIGURE 6. Schematic drawing of apparatus with which experiment was conducted.

Conclusions

Figure 2 shows the curves for spheres with different coefficients of drag and Reynolds numbers from the experimental data, compared to the curve of spheres shown by Rouse or Wadell, to see if there is any correlation. From the curves it can be seen that for the same Reynolds number the experimental data has a little higher coefficient of drag, but has the same general trend that Rouse shows.

Figure 1 shows coefficient of drag plotted against Reynolds number for irregular or flat particles and spheres. As it should be, there are two definite curves, one curve for spheres and one for flat particles. It can be seen by these curves that as the diameter of the particles decreases the coefficient of drag increases. This is confirmed in Wadell's experiment[11] and the curves have the same trends as given in his work.

Figure 3 shows mud velocity against net rise velocity for a glass rectangle. Density and viscosity of the mud were held constant while the mud velocity was the only variable. These curves show that at a low mud velocity there is an increase in the net rise velocity of a cutting when there is no surge present; however, as the mud velocity was increased to a velocity of about 3.6 feet per second, the curves with and without surge crossed and at a mud velocity of 3.83 feet per second the cutting with the surge had a higher net rise velocity. Figure 4 shows mud velocity against slip velocity for the same cutting. These curves show a smaller slip velocity for the cutting without a surge when the mud velocity is less than 3.6 feet per second, but

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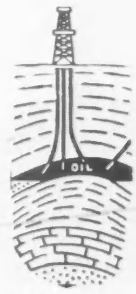

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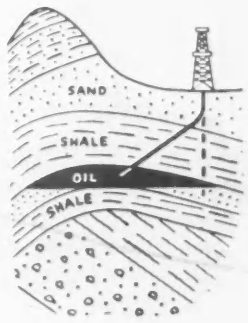

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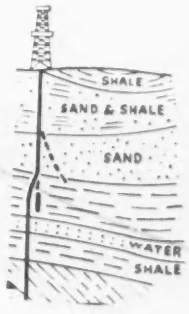

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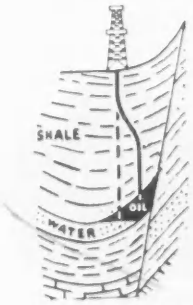
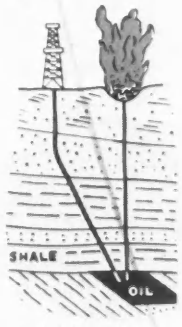


Redrilling Old Wells Profitably



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at this mud velocity the curves again cross and at a mud velocity of 3.83 feet per second the cutting with a surge had a smaller slip velocity.

Figure 5 shows viscosity plotted against net rise velocity for the same glass rectangle with the density and velocity of the mud held constant. The only variable was the viscosity of the mud which varied from 2.5 to 6 centipoises. These curves show that the net rise velocity is greater for the cutting without the surge than with the surge. The curves also show that for a net rise velocity of 1.6 feet per second the cutting with the surge required a mud viscosity of 4.75 centipoises, whereas the cutting without a surge required a mud viscosity of 3.15 centipoises. Therefore, the mud viscosity could be reduced if the surge was eliminated and still maintain the same net rise velocity that the cutting had when the surge was present.

Curves for the other cuttings were plotted and found to have the same general trend as the curves shown, so they were not plotted for this experiment.

The effect of surges on the viscosity of the mud, as the mud was being pumped up the well bore, was considered constant in this experiment since the curves for spheres and irregular cuttings were continuous and show a very close relationship between all cuttings tested. There is a question as to whether this assumption is correct. To find the effect of surges on the viscosity of muds, tests should be made so that the viscosity could be measured as the mud is pumped up the well bore with and without surge.

As nearly as could be determined from the experimental work on which this report is based, the viscosity of the mud was the same both with and without the surge.

The data sheets and curves show that surges at mud velocities of 3.41 feet per second and below are detrimental in lifting bit cuttings, but at mud velocities higher than 3.41 feet per second more study should be made to determine the trends of the curves plotted. Joseph Zaba[12] shows by his graph that six feet per second is a very high annular velocity for drilling muds. His graphs also indicate that for the average well drilled, a high pumping rate is required to produce an annular mud velocity greater than the 3.6 feet per second which is the velocity where the plotted curves cross. Therefore, for the average well drilled today it would be best to eliminate the surge because the carrying capacity of the drilling mud is materially increased.

About the Author

HENRY CHARLES WACHTMAN, Jr., was born at Skiatook, Okla., and received both B.S. and M.S. degrees in Mechanical Engineering from Oklahoma A. and M. College, Stillwater. During World War II he was an infantryman and was captured by the Germans in the Battle of the Bulge. During school years he obtained practical experience in Mid-Continent oil fields working as a roustabout and is now field engineer, Oil and Gas Division, Osage Indian Agency, Pawhuska, Okla.

Sample Calculations

Reynolds Number:

$$N_R = \frac{D\,V_s\,\rho}{\mu e}$$

N_R = Reynolds number, dimensionless

$$\rho = \frac{w}{g} = \frac{\text{lb. per cu. ft.}}{32.2}$$

μ = Absolute viscosity in centipoises

μe = Centipoises $\times$ 2.089 $\times$ 10^{-5} lb. sec. per sq. ft.

$$D = \text{diameter in feet} = \frac{\text{in.}}{12}$$

D_i = Diameter in inches

V_s = Slip velocity = fps

$$N_R = \frac{D_i\,V_s\,w \times 10^5}{12\,(32.2)\,(2.089)\,\mu}$$

$$N_R = \frac{124\,D_i\,V_s\,w}{\mu}$$

Drag or retarding force:

D = F = Drag or retarding force, pounds

$$D = F = Cd\,A\,\rho_m\frac{V_s^2}{2}$$

Cd = Coefficient of drag, dimensionless

A = Projected area of the object in square feet

ρ_s = Weight of object, pounds per cubic foot

V_s = Slip velocity in feet per second

ρ_m = Weight of the mud, pounds per cubic foot

$$Cd = \frac{2F}{A\,\rho_m\,V_s^2}$$

When velocity reaches equilibrium the retarding force of a particle is equal to:

$$F = \frac{\pi D^3}{6}(\rho_s - \rho_m)g$$

$$\text{Area} = A = \frac{\pi D^2}{4}$$

Substitute F and A in equation for Cd above:

$$Cd = \frac{(4)\,(2)\,\pi D^3\,(\rho_s - \rho_m)\,g}{6\,D^2\,\pi V_s^2\,\rho_m}$$

$$Cd = \frac{4g\,D\,(\rho_s - \rho_m)}{3\,\rho_m V_s^2} = \frac{4\,(32.2)\,D\,(\rho_s - \rho_m)}{3\,(12)\,\rho_m V_s^2}$$

$$Cd = \frac{3.58\,D\,(\rho_s - \rho_m)}{V_s^2\,\rho_m}$$

Sample Calculations for run number six:

Reynolds number:

$$N_R = \frac{124\,D_i\,V\,w}{\mu}$$

D_i = 0.62 in. = 162 lb. per cu. ft.

V_s = 2.031 fps = 63.7 lb. per cu. ft.

w = 162 lb. per cu. ft. = 6 cp

$$N_R = \frac{124\,(.62)\,(2.031)\,(162)}{6}$$

N_R = 4220

Coefficient of drag:

$$Cd = \frac{3.58\,D_i\,(\rho_s - \rho_m)}{\rho_m V_s^2}$$

$$Cd = \frac{3.58\,(.62)\,(162 - 63.7)}{(63.7)\,(2.031)^2}$$

Cd = 0.832

SYMBOLS AND ABBREVIATIONS

A—projected area of the object, sq. in.
c—velocity of surge wave, fps
Cd—coefficient of drag, dimensionless
D—drag force, pounds
E—modulus of elacticity of the pipe, pounds per square inch
F—retarding force, pounds
g—gravitational force, 32.2 feet per second per second
K—modulus of elasticity of the fluid pounds per square inch
N_R—Reynolds number, dimensionless
t—thickness of the pipe, feet
Vm—mud velocity, feet per second
Vs—slip velocity, feet per second
w—weight of the object, pounds per cubic foot
π/ft^3—pounds per cubic foot
ρ—density, pounds per cubic foot
ρ_m—density of the mud, pounds per cubic foot
ρ_s—density of the object, pounds per cubic foot
μ—viscosity, centipoise

BIBLIOGRAPHY

[1] Ambrose, H. A., and Loomis, A. C., "Fluidities of Thixotropic Gels; Bentonite Suspensions," *Physics 4*, 265, 1933.

[2] Beck, R. W., Nuss, W. F., and Dunn, T. H., "The Flow Properties of Drilling Muds," *API Drilling and Production Practice*, (1947), 9-22. Also World Oil, Vol. 128, No. 10 (Feb. 1) 1949.

[3] Bingham, E. C., *Fluidity and Plasticity*, McGraw Hill (1922).

[4] Dawson, F. M., and Kalinske, A. A., "Methods of Calculating Water-Hammer Pressures," *Journal of the American Water Works Association*, Nov., 1939.

[5] Evans, P., and Reid, A., "Drilling Mud. Its Manufacture and Testing," *Trans. Mining Geol. Inst. of India*, 32, 1 (1936).

[6] Gregory, W. B., "Pumping Clay Slurries Through 4-inch Pipe," *Mechanical Engineering*, 49, 1409 (1927).

[7] Hall, H. N., Thompson, H., and Nuss, Frank, "Ability of Drilling Mud to Lift Bit Cuttings," *Petroleum Technology*, Feb. 1950, T. P. 2782.

[8] McNown, J. S., "Influence of Boundary Proximity on the Drag of Spheres," *State University of Iowa Reprints in Engineering*, Reprint No. 11.

[9] Pigott, R. J. S., "Mud Flow in Drilling," *API Drilling and Production Practice*, (1941), 91-103.

[10] Rouse, Hunter, *Elementary Mechanics of Fluids*, John Wiley & Sons.

[11] Wadell, H., "The Coefficient of Resistance as a Function of Reynolds Number for Solids of Various Shapes," *Journal of the Franklin Institute*, 217, 1934, 459-490.

[12] Zaba, Joseph, "Modern Rotary Drilling," No. 13, Reprinted from *The Oil and Gas Journal*.

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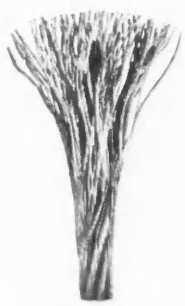

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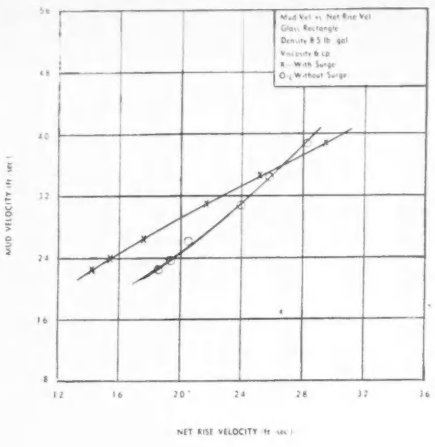

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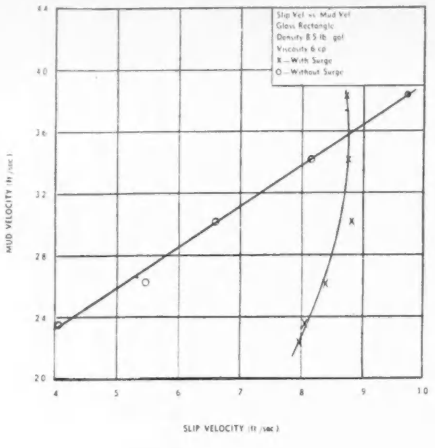

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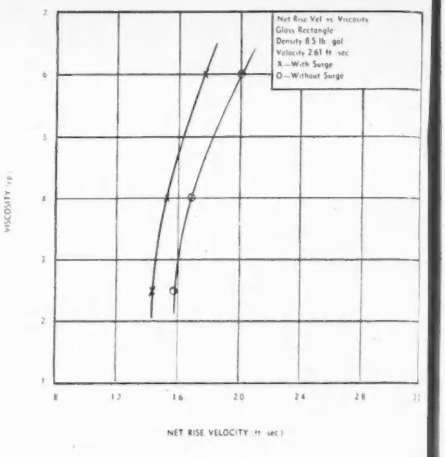

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Eight cuttings of each shape and size were injected for each test and their net rise velocity was measured by a stop watch for a distance of three feet of travel up the well bore. These tests were run first without a surge and then with a surge on the mud flow, so that the difference in the net rise velocity could be obtained under otherwise identical conditions. From such data, slip velocities can be calculated and plotted on a graph to show the effect of surges on the carrying capacity of drilling muds.

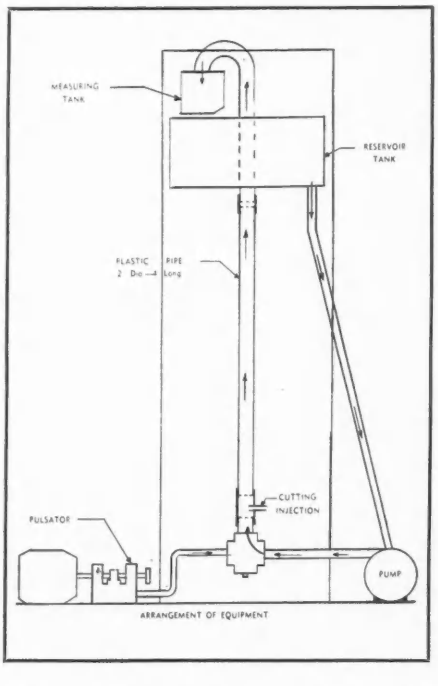

FIGURE 6. Schematic drawing of apparatus with which experiment was conducted.

Conclusions

Figure 2 shows the curves for spheres with different coefficients of drag and Reynolds numbers from the experimental data, compared to the curve of spheres shown by Rouse or Wadell, to see if there is any correlation. From the curves it can be seen that for the same Reynolds number the experimental data has a little higher coefficient of drag, but has the same general trend that Rouse shows.

Figure 1 shows coefficient of drag plotted against Reynolds number for irregular or flat particles and spheres. As it should be, there are two definite curves, one curve for spheres and one for flat particles. It can be seen by these curves that as the diameter of the particles decreases the coefficient of drag increases. This is confirmed in Wadell's experiment[11] and the curves have the same trends as given in his work.

Figure 3 shows mud velocity against net rise velocity for a glass rectangle. Density and viscosity of the mud were held constant while the mud velocity was the only variable. These curves show that at a low mud velocity there is an increase in the net rise velocity of a cutting when there is no surge present; however, as the mud velocity was increased to a velocity of about 3.6 feet per second, the curves with and without surge crossed and at a mud velocity of 3.83 feet per second the cutting with the surge had a higher net rise velocity. Figure 4 shows mud velocity against slip velocity for the same cutting. These curves show a smaller slip velocity for the cutting without a surge when the mud velocity is less than 3.6 feet per second, but

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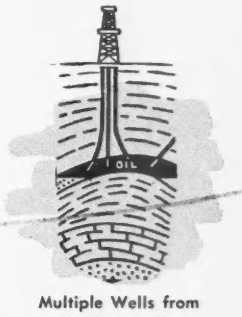

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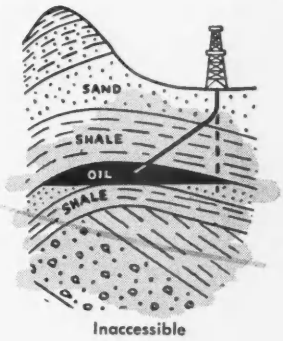

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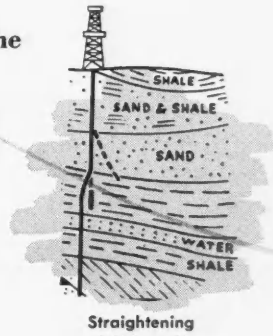

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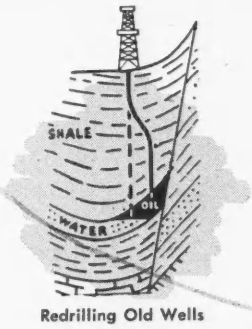
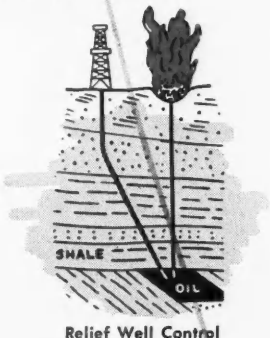


Redrilling Old Wells Profitably



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at this mud velocity the curves again cross and at a mud velocity of 3.83 feet per second the cutting with a surge had a smaller slip velocity.

Figure 5 shows viscosity plotted against net rise velocity for the same glass rectangle with the density and velocity of the mud held constant. The only variable was the viscosity of the mud which varied from 2.5 to 6 centipoises. These curves show that the net rise velocity is greater for the cutting without the surge than with the surge. The curves also show that for a net rise velocity of 1.6 feet per second the cutting with the surge required a mud viscosity of 4.75 centipoises, whereas the cutting without a surge required a mud viscosity of 3.15 centipoises. Therefore, the mud viscosity could be reduced if the surge was eliminated and still maintain the same net rise velocity that the cutting had when the surge was present.

Curves for the other cuttings were plotted and found to have the same general trend as the curves shown, so they were not plotted for this experiment.

The effect of surges on the viscosity of the mud, as the mud was being pumped up the well bore, was considered constant in this experiment since the curves for spheres and irregular cuttings were continuous and show a very close relationship between all cuttings tested. There is a question as to whether this assumption is correct. To find the effect of surges on the viscosity of muds, tests should be made so that the viscosity could be measured as the mud is pumped up the well bore with and without surge.

As nearly as could be determined from the experimental work on which this report is based, the viscosity of the mud was the same both with and without the surge.

The data sheets and curves show that surges at mud velocities of 3.41 feet per second and below are detrimental in lifting bit cuttings, but at mud velocities higher than 3.41 feet per second more study should be made to determine the trends of the curves plotted. Joseph Zaba[12] shows by his graph that six feet per second is a very high annular velocity for drilling muds. His graphs also indicate that for the average well drilled, a high pumping rate is required to produce an annular mud velocity greater than the 3.6 feet per second which is the velocity where the plotted curves cross. Therefore, for the average well drilled today it would be best to eliminate the surge because the carrying capacity of the drilling mud is materially increased.

About the Author

HENRY CHARLES WACHTMAN, Jr., was born at Skiatook, Okla., and received both B.S. and M.S. degrees in Mechanical Engineering from Oklahoma A. and M. College, Stillwater. During World War II he was an infantryman and was captured by the Germans in the Battle of the Bulge. During school years he obtained practical experience in Mid-Continent oil fields working as a roustabout and is now field engineer, Oil and Gas Division, Osage Indian Agency, Pawhuska, Okla.

Sample Calculations

Reynolds Number:

$$N_R = \frac{D\, V_s\, \rho}{\mu e}$$

N_R = Reynolds number, dimensionless

$$\rho = \frac{w}{g} = \frac{\text{lb. per cu. ft.}}{32.2}$$

μ = Absolute viscosity in centipoises

μe = Centipoises $\times$ 2.089 $\times$ 10^{-5} lb. sec. per sq. ft.

$$D = \text{diameter in feet} = \frac{\text{in.}}{12}$$

D_i = Diameter in inches

V_s = Slip velocity = fps

$$N_R = \frac{D_i\, V_s\, w \times 10^5}{12\ (32.2)\ (2.089)\ \mu}$$

$$N_R = \frac{124\, D_i\, V_s\, w}{\mu}$$

Drag or retarding force:

$\overline{D}$ = F = Drag or retarding force, pounds

$$\overline{D} = F = Cd\, A\, \rho_m \frac{V_s^2}{2}$$

Cd = Coefficient of drag, dimensionless

A = Projected area of the object in square feet

ρ_s = Weight of object, pounds per cubic foot

V_s = Slip velocity in feet per second

ρ_m = Weight of the mud, pounds per cubic foot

$$Cd = \frac{2\, F_2}{A\, \rho_m\, V_s}$$

When velocity reaches equilibrium the retarding force of a particle is equal to:

$$F = \frac{\pi\, D^3}{6} \qquad (\rho_s - \rho_m)\, g$$

$$\text{Area} = A = \frac{\pi\, D^2}{4}$$

Substitute F and A in equation for Cd above:

$$Cd = \frac{(4)\ (2)\ \pi\, D^3\ (\rho_s - \rho_m)\, g}{6\, D^2\, \pi\, V_s^2\, \rho_m}$$

$$Cd = \frac{4g\, D\ (\rho_s - \rho_m)}{3\, \rho_m\, V_s^2} = \frac{4\ (32.2)\ D\ (\rho_s - \rho_m)}{3\ (12)\ \rho_m\, V_s^2}$$

$$Cd = \frac{3.58\, D\ (\rho_s - \rho_m)}{V_s^2\, \rho_m}$$

Sample Calculations for run number six:

Reynolds number:

$$N_R = \frac{124\, D_i\, V\, w}{\mu}$$

D_i = 0.62 in. = 162 lb. per cu. ft.

V_s = 2.031 fps = 63.7 lb. per cu. ft.

w = 162 lb. per cu. ft. = 6 cp

$$N_R = \frac{124\ (.62)\ (2.031)\ (162)}{6}$$

N_R = 4220

Coefficient of drag:

$$Cd = \frac{3.58\, D_i\ (\rho_s - \rho_m)}{\rho_m\, V_s^2}$$

$$Cd = \frac{3.58\ (.62)\ (162 - 63.7)}{(63.7)\ (2.031)^2}$$

Cd = 0.832

SYMBOLS AND ABBREVIATIONS

A—projected area of the object, sq. in.
c—velocity of surge wave, fps
Cd—coefficient of drag, dimensionless
D—drag force, pounds
E—modulus of elasticity of the pipe, pounds per square inch
F—retarding force, pounds
g—gravitational force, 32.2 feet per second per second
K—modulus of elasticity of the fluid pounds per square inch
N_R—Reynolds number, dimensionless
t—thickness of the pipe, feet
Vm—mud velocity, feet per second
Vs—slip velocity, feet per second
w—weight of the object, pounds per cubic foot
#/ft³—pounds per cubic foot
ρ—density, pounds per cubic foot
ρ_m—density of the mud, pounds per cubic foot
ρ_s—density of the object, pounds per cubic foot
μ—viscosity, centipoise

BIBLIOGRAPHY

[1] Ambrose, H. A., and Loomis, A. C., "Fluidities of Thixotropic Gels; Bentonite Suspensions," *Physics 4*, 265, 1933.

[2] Beck, R. W., Nuss, W. F., and Dunn, T. H., "The Flow Properties of Drilling Muds," *API Drilling and Production Practice*, (1947), 9-22. Also World Oil, Vol. 128, No. 10 (Feb. 1) 1949.

[3] Bingham, E. C., *Fluidity and Plasticity*, McGraw Hill (1922).

[4] Dawson, F. M., and Kalinske, A. A., "Methods of Calculating Water-Hammer Pressures," *Journal of the American Water Works Association*, Nov., 1939.

[5] Evans, P., and Reid, A., "Drilling Mud—Its Manufacture and Testing," *Trans. Mining Geol. Inst. of India*, 32, 1 (1936).

[6] Gregory, W. B., "Pumping Clay Slurries Through 4-inch Pipe," *Mechanical Engineering*, 49, 609 (1927).

[7] Hall, H. N., Thompson, H., and Nuss, Frank, "Ability of Drilling Mud to Lift Bit Cuttings," *Petroleum Technology*, Feb., 1950, T. P. 2782.

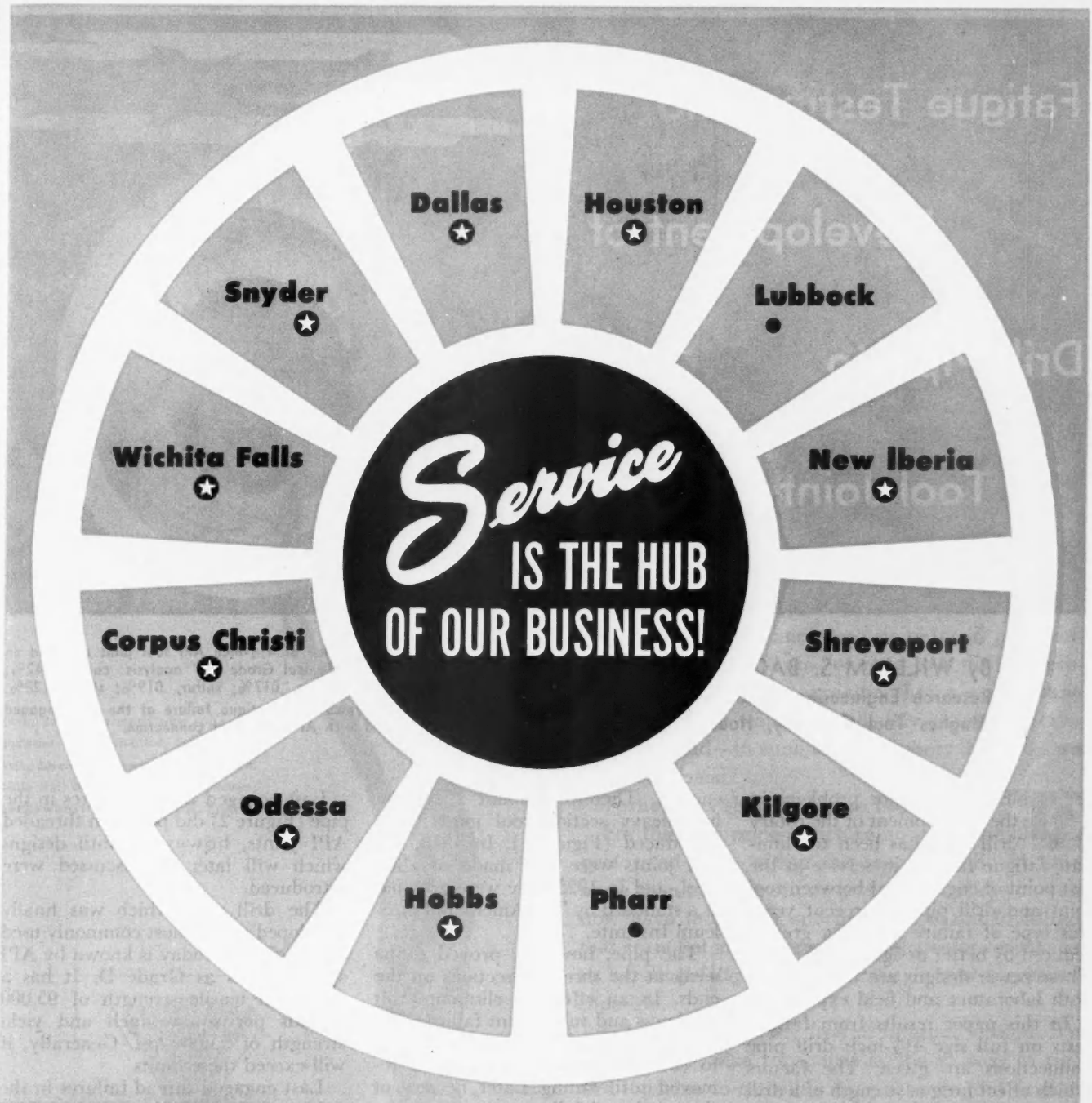
[8] McNown, J. S., "Influence of Boundary Proximity on the Drag of Spheres," *State University of Iowa Reprints in Engineering*. Reprint No. 81.

[9] Pigott, R. J. S., "Mud Flow in Drilling," *API Drilling and Production Practice* (1941), 91-103.

[10] Rouse, Hunter, *Elementary Mechanics of Fluids*, John Wiley & Sons.

[11] Wadell, H., "The Coefficient of Resistance as a Function of Reynolds Number for Solids of Various Shapes," *Journal of the Franklin Institute*, 217 (1934), 459-490.

[12] Zaba, Joseph, "Modern Rotary Drilling," No. 43, Reprinted from *The Oil and Gas Journal*.



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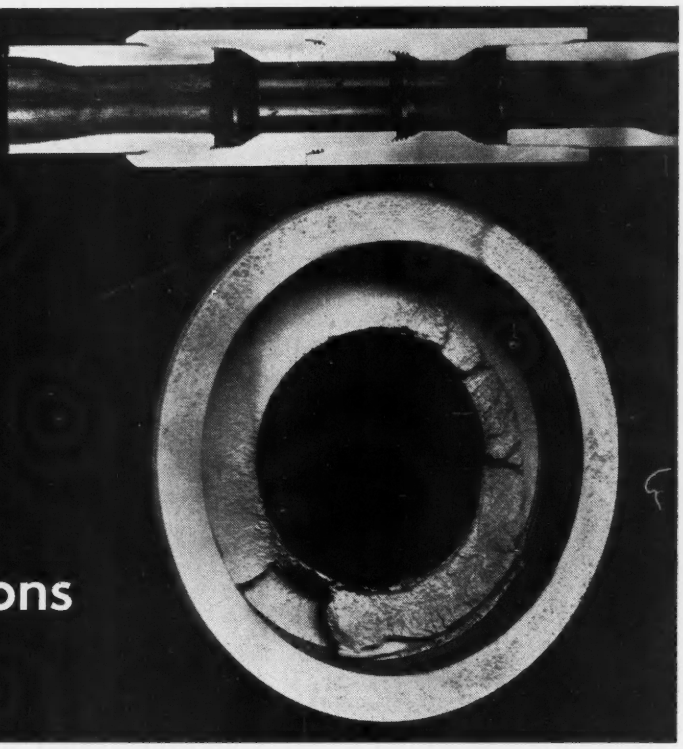
Fatigue Testing and Development of Drill Pipe to Tool Joint Connections



By WILLIAM S. BACHMAN
Research Engineering Department
Hughes Tool Company, Houston

FIGURE 1 (top). Cross-section of 4½-inch API tool joint installed on internal upset drill pipe. Typical Grade "D" analysis: carbon, .42%; manganese, 1.35%; phosphorus, .017%; sulfur, .019%; silicon, .20%.
FIGURE 2 (bottom). Typical pipe fatigue failure at the last engaged thread with API tool joint connection.

ONE of the major problems in the development of the rotary drill stem has been to eliminate fatigue failures in service at the last point of engagement between tool joint and drill pipe. In recent years this type of failure has been greatly reduced by better designed tool joints. These newer designs are the result of both laboratory and field experience.

In this paper results from fatigue tests on full sige 4½-inch drill pipe connections are given. The factors which affect fatigue strength of a drill pipe connection are also discussed, and there is included a sample fatigue strength problem to demonstrate how the higher fatigue stress values of the newer type connections have practically eliminated failures at the tool joints.

The first drill pipe was a low carbon butt-welded or lap-welded pipe with short couplings of similar material. Failures soon proved such a pipe unsatisfactory for deeper drilling, and the hot-rolled and pierced seamless tubing was introduced, made of higher carbon, higher tensile strength steel.

Because of the necessity of continually making-up and breaking-out the joints, it soon became apparent that the short fine thread couplings could neither stand hard usage nor be made-up and broken-out fast enough. Therefore, about 1910, the first heavy section tool joints were introduced (Figure 1). In 1918, the tool joints were first made of alloy steel, and in 1925 they were adopted as a standard by The American Petroleum Institute.

The pipe, however, proved to be weak at the threaded sections on the ends. In an effort to eliminate this weakness and subsequent failures, the pipe was upset on the ends enough to compensate for the material removed in threading. Later, because of the continued failures, the upset was eventually increased to as much as 2½ times the thickness of the body of the pipe (Figure 1). Threads were also changed from sharp to rounded crests and roots in an effort to reduce stress concentration.

Last engaged thread failures in the pipe (Figure 2) did persist in threaded API joints, however, until designs which will later be discussed were introduced.

The drill pipe which was finally developed and is most commonly used in the oil field today is known by API specifications as Grade D. It has a minimum tensile strength of 95,000 pounds per square inch and yield strength of 55,000 psi. Generally, it will exceed these limits.

Last engaged thread failures in the field are generally due to some form of bending fatigue. The bending of the pipe may be caused by crooked hole, running the pipe in compression to apply weight to the bit, slightly unbalanced sections of the pipe turning at high revolutions per minute, and

"THE DATA on fatigue strength of full-size drill pipe and tool joints presented in this paper are of especial interest to the worker on the theoretical aspects of metallic failure. These results, collected over a period of 15 years from more than 1000 individual full-sized tests made by the Hughes Tool Company Laboratory, represent a substantial portion of the fatigue information ever published on the strength of large diameter specimens of any type. This type of information is imperative if we are ever to understand the serious question of size effect," wrote Dr. Robert Plunkett, Mechanical Engineering department, The Rice Institute, on this paper as presented at the annual meeting of the Petroleum Section, ASME, at New Orleans.

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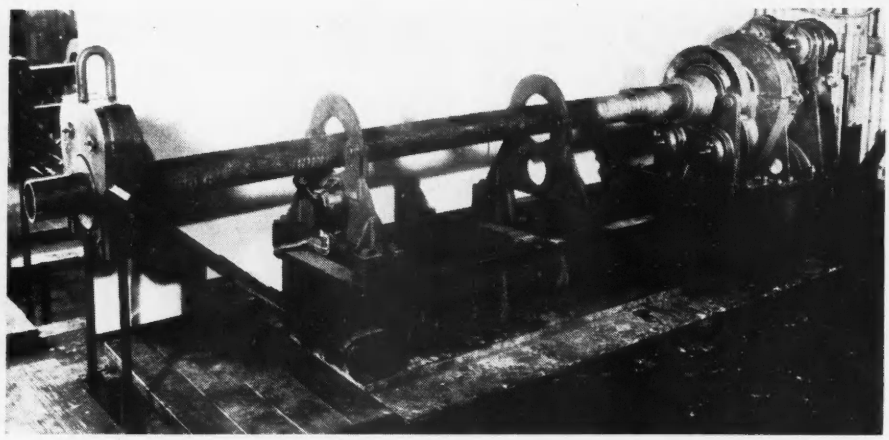


FIGURE 3. Fatigue test machine for full-size drill pipe specimens.

general vibrations throughout the string. Each tool joint with its size larger than that of the adjacent pipe acts as an excellent mass concentration to set up transverse vibrations. In addition to bending the joint is also subjected to torsion, and superimposed on both is tension or compression. This combined load is applied on the last engaged thread which acts as a notch, and the notch creates a stress concentration point. The notch will materially reduce the fatigue failure stress below its value for the normal wall section without threads.

The failure stress is difficult to calculate mathematically and generally full-size tests are necessary to accurately determine the fatigue strength of a connection.

In order to duplicate in the laboratory the bending fatigue type loading of drill stem in the field, the large rotating-beam fatigue test machine shown in Figure 3 is used. This machine consists of a spindle for holding a ten-foot section of drill pipe with tool joint installed, a motor for turning the spindle at 300 rpm, and a weighted member mounted on roller bearings at the end of the pipe opposite the spindle to apply the bending load.

Rotation of the pipe under load subjects the member to completely reversed bending stresses. It is believed that this type of stressing is a reliable criterion from which the relative values of fatigue failure strength could be obtained for various designs of tool joint connections.

For most test work a tool joint is installed on a piece of drill pipe with an upset end. In practically all cases using the newer type joints a break will occur in the body of the pipe before it fails at the tool joint. This information is usually sufficient—that is, the connection is stronger than the body of the pipe. However, when it is desirable to compare various types of joint construction, it is necessary to use special thick section pipe the same length as the regular drill pipe test section to insure failure at the tool joint.

Factors Affecting Fatigue Results

The following is a brief outline of several factors which affect fatigue results obtained from tests on drill pipe specimens:

SURFACE CONDITIONS: Any irregularities on the surface of the pipe act as tiny stress raisers, forming nuclei from which fatigue cracks can propagate. Small pits, tong and slip marks, hammer peening dents, steel stencil letter marks, or any number of other marks may be found on drill pipe in use. Hence, drill pipe will have a lower fatigue strength than comparable tubular laboratory specimens of the same size which have machined and polished surfaces.

NOTCHES: In the case of the machined threaded sections at the end of the pipe, the many small surface discontinuities are reduced by machining, however, when a notch in the form of a thread is introduced, this acts as an even greater stress raiser than the small pits in the body of the pipe.

Different steels react differently to notches. This is known as the notch sensitivity of a steel. As a general rule, in the absence of corrosion or stress raisers such as notches, polished specimens of heat-treated alloy or high carbon steel have a higher fatigue strength than the lower tensile strength steels. When a notch is introduced, however, the higher tensile strength steels are affected to a greater degree than the lower strength steels. To illustrate this fact, it was found on a number of actual tests on 4½-inch diameter SAE 3140 heat-treated alloy steel specimens that the fatigue failure stress is reduced from 30,000 psi for the unnotched sections to 10,000 psi for the notched or threaded sections. In the case of the medium carbon steel in drill pipe, the reduction in the fatigue failure stress was only from 27,000 psi for the unnotched to 15,000 psi for notched sections. Therefore, the steel in the drill pipe is not as notch sensitive as the alloy steel in the tool joint.

CHANGE IN SECTION AND CLAMPING STRESSES: In the case of some designs where the pipe is supported in the counterbore by a section outside of the last engaged thread (Figure 7-A), there is a natural stress raiser at the end due to the change in section known as the

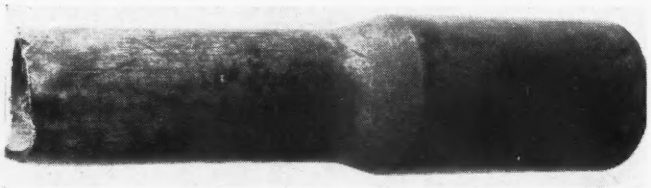
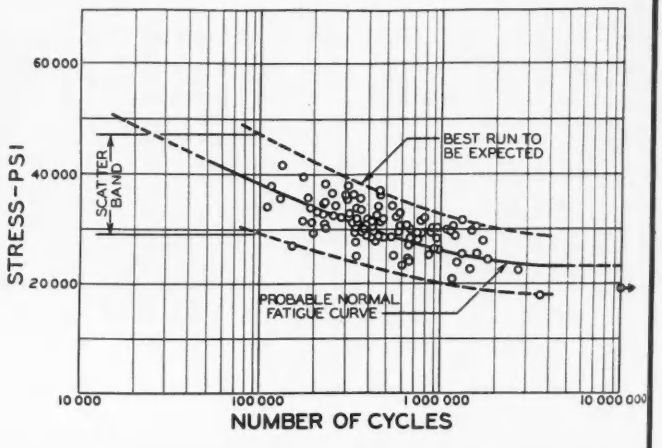


FIGURE 4-A (above). Typical failure in body of 4½-inch drill pipe.

FIGURE 4-B (right). Fatigue failure in body of drill pipe.



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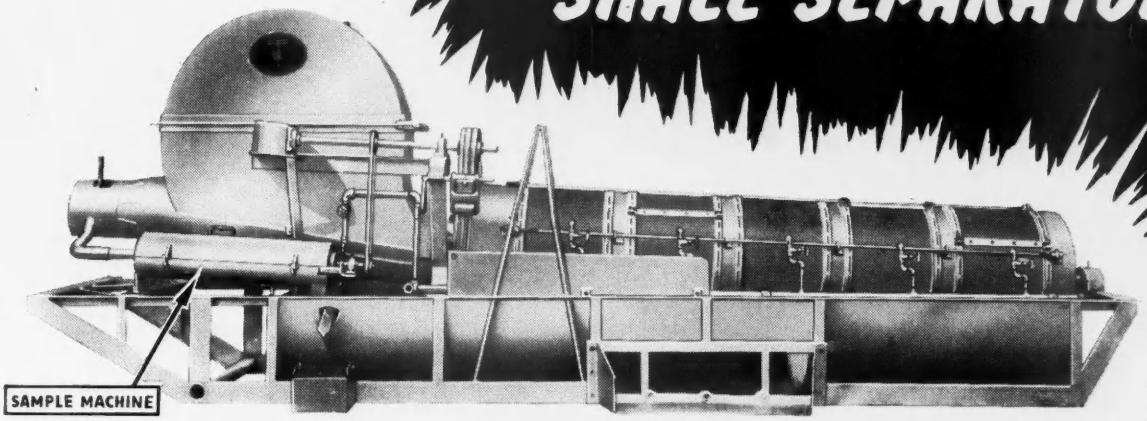

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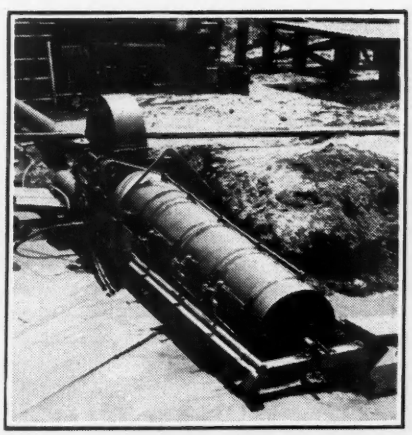

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"square shoulder effect." This effect is not as great a stress raiser, however, as the notch effect of a thread.

Theory would seem to indicate that the clamping stress produced in the pipe by a shrink-type joint (Figure 10-A), utilizing a tightly shrunk-on land at the pipe-end of the joint, might affect the fatigue strength. However, to date this effect has not shown up on test specimens. The stress raiser due to the "square shoulder effect" produced by the end of the joint is apparently greater than the clamping effect of the joint, and apparently the two stress raisers are not additive.

To demonstrate this, consider the welded construction of Figure 7-A where there is a square shoulder and no clamping, and the shrink-type construction of Figure 10-A where there is a square shoulder plus clamping. Both joints have a fatigue failure stress of 20,000 psi. To insure that there was no additional stress raiser caused by welding of the material at the shoulder, several tests were run on joints of pipe with large external upsets machined to form square shoulders directly in the pipe steel. These special square shoulder joints with no weld and no clamping stress still indicated a fatigue failure stress of 20,000 psi.

CORROSION FATIGUE: In the field, probably the greatest number of fatigue failures of pipe can be attributed to conditions resulting from corrosion. In the presence of a corrosive medium in the drilling mud, the pipe and connections in use under stress are quickly attacked by corrosion, and cracks and pits form on the surface layers. The problems in every corrosive area are different, and therefore hard to duplicate in laboratory tests.

Time, temperature, corrosive medium, and the type of steel are the four factors present in any corrosion-fatigue problem. In order to make testing feasible in the laboratory, corrosion is accelerated, the time element is greatly reduced, and the activeness of the corrosive fluid is increased. When these various changes from

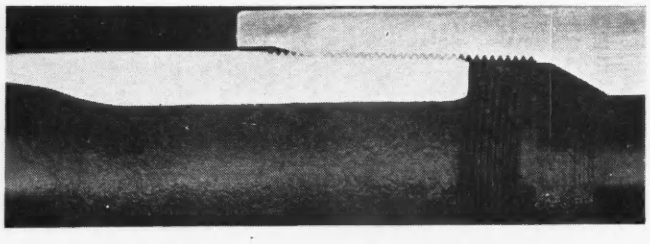

FIGURE 5-A (above). API threaded connection.

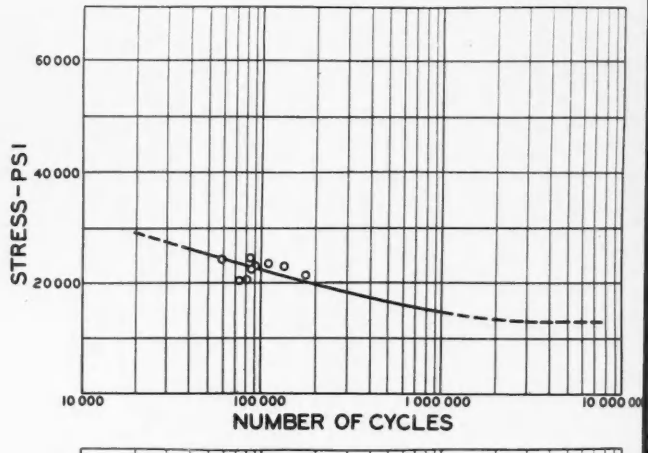

FIGURE 5-B (right). Fatigue curve—API threaded connection—failures at last engaged pipe thread.

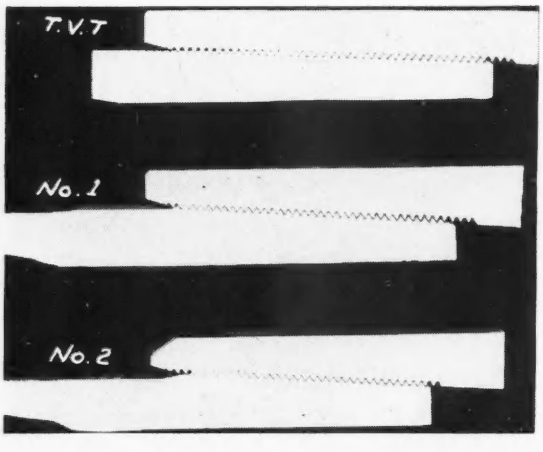

FIGURE 6-A. Vanishing thread connections.

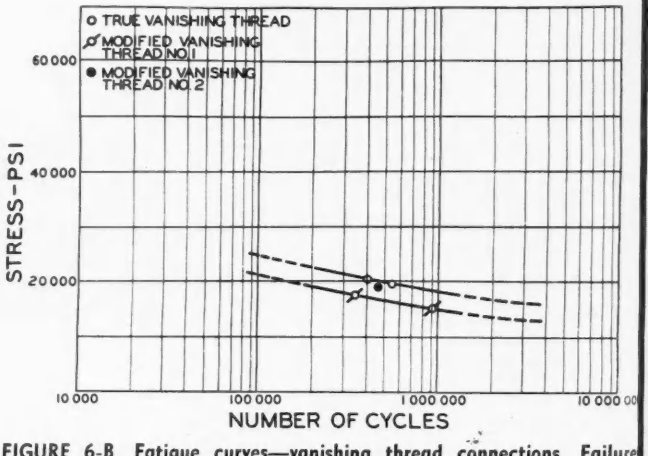

FIGURE 6-B. Fatigue curves—vanishing thread connections. Failure at last engaged thread.

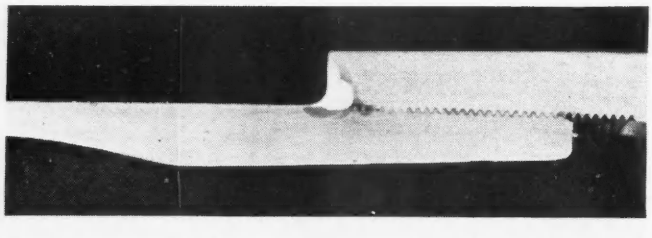

FIGURE 7-A (above). API threaded connection with welded pipe end.

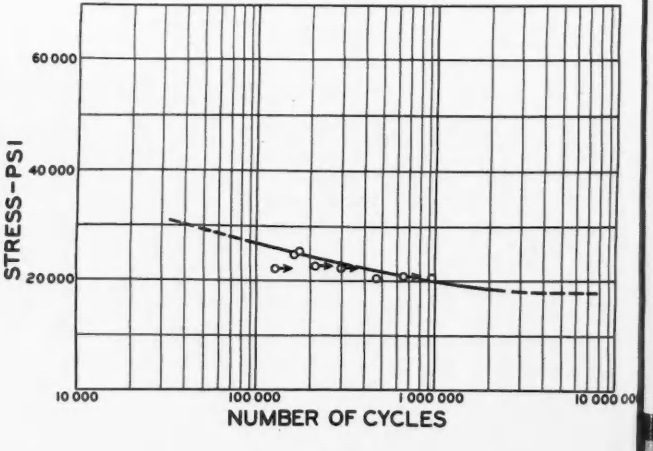

FIGURE 7-B (right). Fatigue curve—API threaded connection with welded pipe end—failures in pipe at tool joint shoulder.

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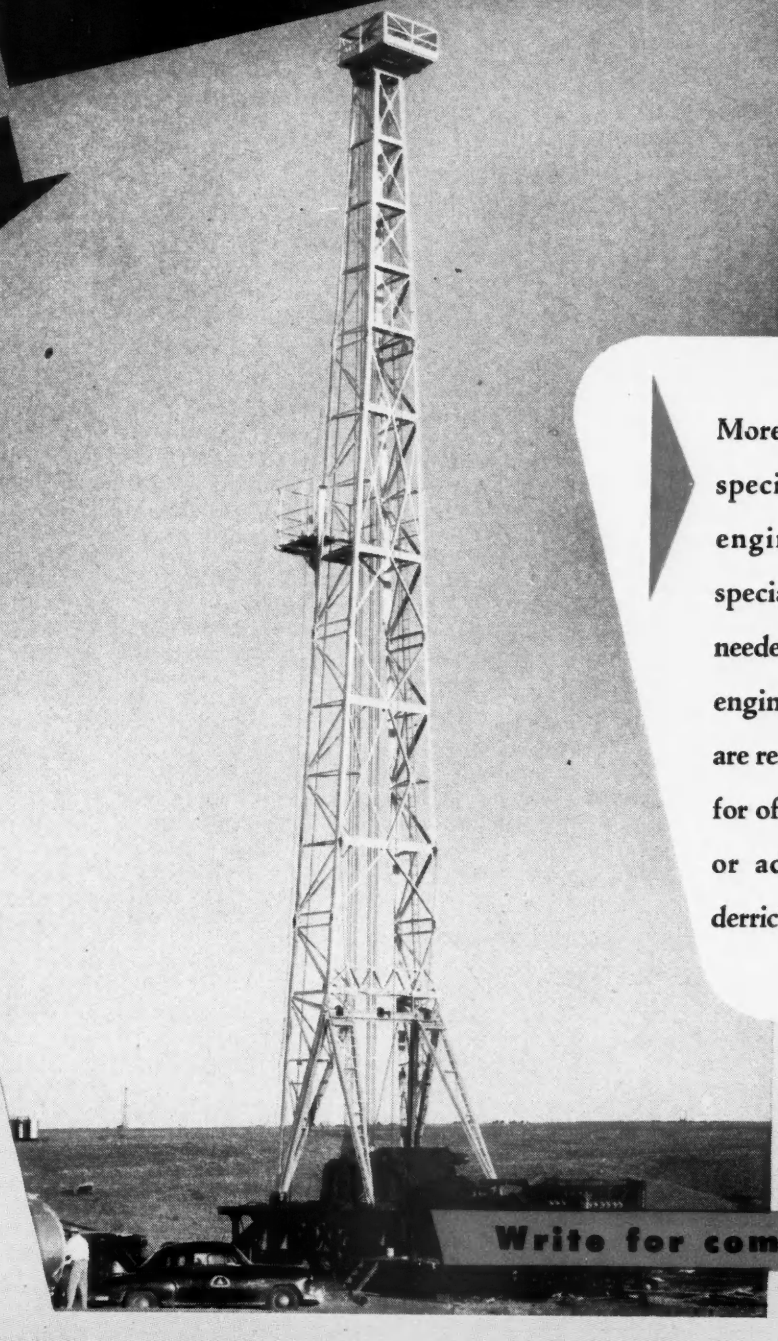

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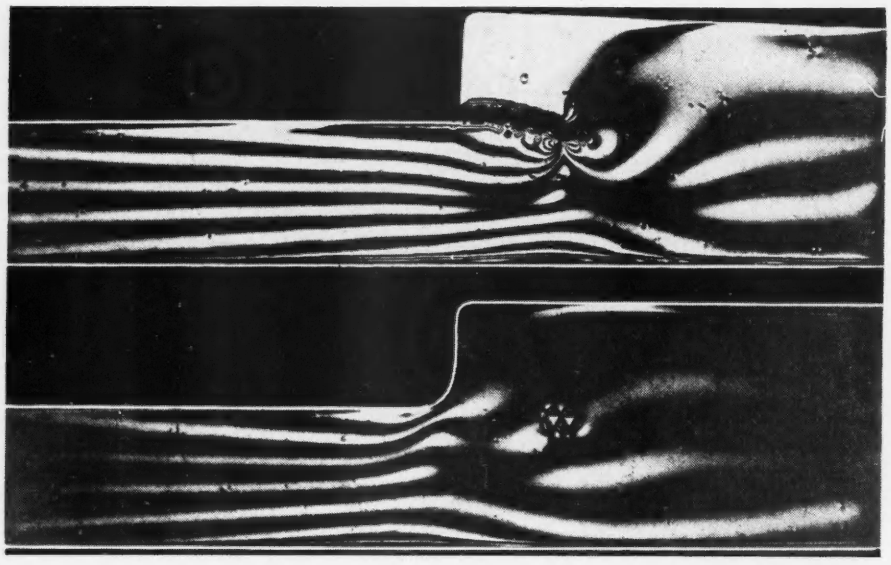


FIGURE 8. Photo-elastic study of stress concentration at last engaged thread. The top view shows the stress concentration present at the last engaged thread in an API connection. The lower view demonstrates the reduction of stress concentration by the addition of a welded band adjacent to the last engaged thread.

actual field conditions are made, the fatigue results obtained to date on full-size drill pipe are not too reliable. The test results given in this paper are on non-corroded specimens. However, in any tool joint design corrosion should be considered.

There is no endurance limit in a corrosion fatigue test. Time keeps changing conditions of the pipe. Instead of the fatigue curve becoming comparatively straight at about 4 million cycles as shown in Figure 4-B, the failure stress continually decreases the longer the specimen is allowed to corrode.

To illustrate this, Figure 4-B indicates the normal endurance limit of Grade D 16.60 pounds per foot drill pipe to be 24,000 psi at 10 million cycles. R. C. Bowden[9] of the National Tube Company said they found that Grade D drill pipe has a corrosive endurance limit of approximately 10,000 psi at 10 million cycles when corroded over a period of 40 days. From these figures the high degree of reduction in the fatigue strength resulting from corrosion is readily apparent.

SIZE EFFECT: The fatigue stress necessary to produce failure of a member is reduced with an increase in size. It was found in the Battelle investigation of drill pipe failures[7] that three-eighth-inch machined specimens made of the steel comparable to that used in Grade D drill pipe had an endurance limit of 48,000 psi. When compared to a normal endurance limit of 24,000 psi on full size 4½-inch drill pipe, the effect of size is apparent even though surface conditions were different.

Size, causing differences in fatigue strength, is considered by some authorities to be a result of the greater amount of material present, and hence there is more chance of a stress raiser being present to form the nucleus of a fatigue crack. If the crack starts, the remaining material is progressively subjected to an ever-increasing stress as the crack propagates, and failure will soon occur.

The fact that size is so important makes testing of full-size specimens very helpful in comparing various structures. All test results given in this paper are restricted to 4½-inch drill pipe to try to eliminate the variable of size effect in the discussion.

In order to interpret these fatigue results, a conventional S-N (stress-no. cycles) or endurance limit curve is plotted on semi-log paper (Figure 4-B). All points on this chart are actual failures at a given section of the test specimens except those points with arrows attached. The arrow indicates that the section in question had not failed at the time the test was stopped.

The endurance limit for steel, the highest stress at which a specimen will run indefinitely without failure, can usually be determined in 4 million to 10 million cycles. In this paper, the failure stress at 1 million cycles is used for comparison and will be slightly higher than the endurance limit. This practice is believed to be satisfactory in determining relative strengths where the same type of steel and same size specimen are used, and only the form of stress concentration at the point of failure changed such as notches, shoulders, etc. In this case, the percentage difference in fatigue stress values on the S-N curves for two different constructions should be approximately the same at 1 million and 4 million cycles.

In any tool joint design the primary objective is to make the pipe to tool joint connection stronger than the body of the pipe, in order that the strength of the entire string will be limited only by the strength of the body of the pipe itself.

The fatigue strength of any section of pipe is determined by the bending moment necessary to produce failure. The bending moment is calculated from the simple flexure formula:

(Bending moment = Fatigue Failure Stress × Section Modulus)

The body of the pipe has a high fatigue failure stress and a low section modulus. The pipe at the tool joint connection has a lower fatigue stress, but a higher section modulus because of the pipe upset. The problem has been to design a connection

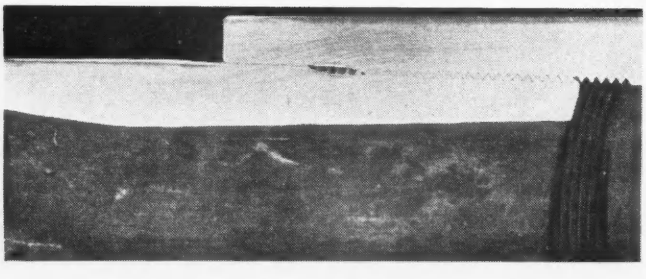
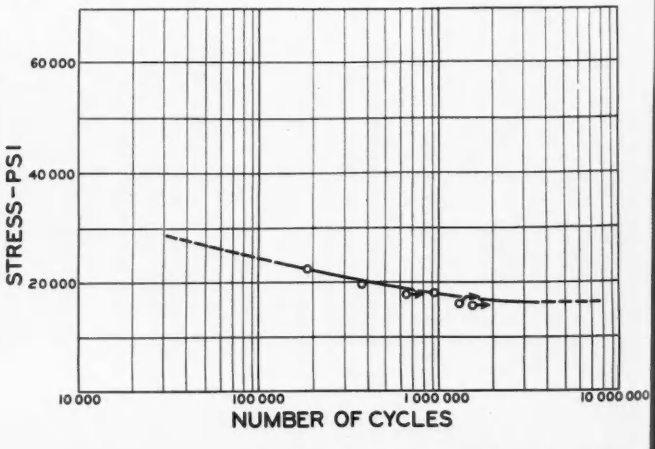


FIGURE 9-A (above). Bucked-on threaded connection with supporting land outside of last engaged thread.

FIGURE 9-B (right). Bucked-on threaded connection with supporting land outside of last engaged pipe thread. Failures in pipe at tool joint shoulder.



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in which the product of fatigue failure stress and the section modulus is higher at the tool joint than in the body of the pipe.

Better designs having less concentrated stress at the connection have accounted for most of the increase in the fatigue strength of the new type connections. The pipe upset has been increased only slightly, if any. Larger upsets are undesirable because the original cost is increased and hydraulic efficiency is decreased.

The drill pipe scatter band, representing the difference in fatigue strength between the best and the worst specimens, is wide (Figure 4-B). In addition to surface pits and mill scale causing scatter, the hardness of the test specimens would also be a contributing factor.

Referring to Figure 4-B, "Fatigue Failures in Body of Drill Pipe," there are two significant fatigue curves shown: (1) the normal fatigue curve; and (2) the "best run to be expected" curve. To eliminate the possibility of an occasional piece of pipe being stronger in the body than at the tool joint connection, the connection is designed stronger than the best pipe specimens represented by the "best run to be expected" curve. This design value at 1 million cycles would be approximately 32,500 psi for 4½-inch Grade D 16.60 pounds per foot drill pipe. The normal fatigue curve, representing an average specimen, would indicate a stress necessary to produce failure of only 27,000 psi at 1 million cycles.

Tool joints may be classified according to their pipe connections as follows:

Threaded pipe-end connections.

Threaded pipe-end connections with welded end adjacent threaded section.

Threaded pipe-end connectio with supporting land adjacent the threaded section.

Welded-on or unitized connectio

Other types.

Fatigue tests are available on least one or more types under ea of these general headings and sho be sufficient to indicate what mig be expected of most designs.

THREADED PIPE-END CONNE TIONS: 1. Regular API Thread Connection (Figure 5-A). The fa ures shown on Figure 5-B occur in the pipe at the last engaged thre In this particular construction failu will generally occur at this po rather than in the body of the pi Most of the tests failed in the vicin of 100,000 cycles. By extrapolati

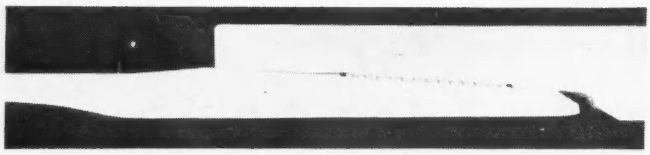


FIGURE 10-A (above). Shrink type threaded connection with supporting land outside of last engaged pipe thread.

FIGURE 10-B (right). Failures in pipe at tool joint shoulder.

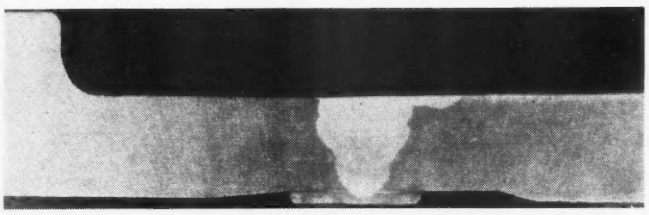


FIGURE 11-A (above). Hand-weld connection.

FIGURE 11-B (right). Fatigue curve—hand-weld connections—failures in weld.

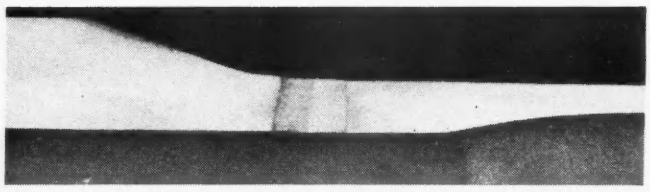
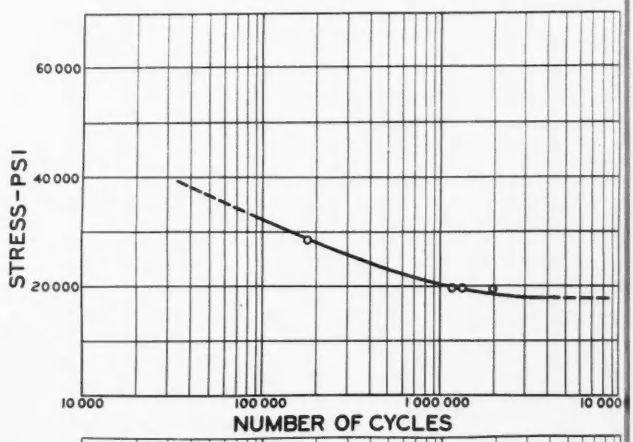
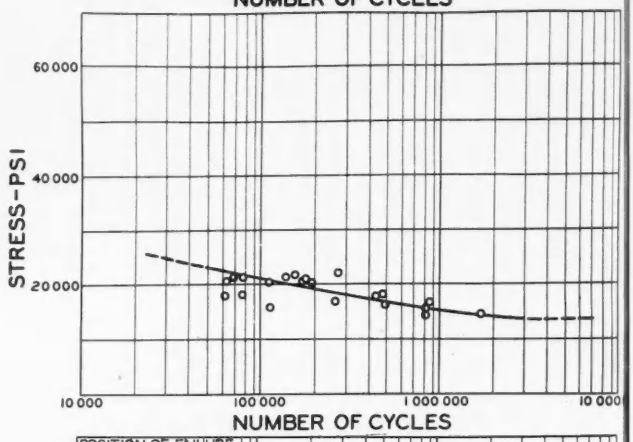
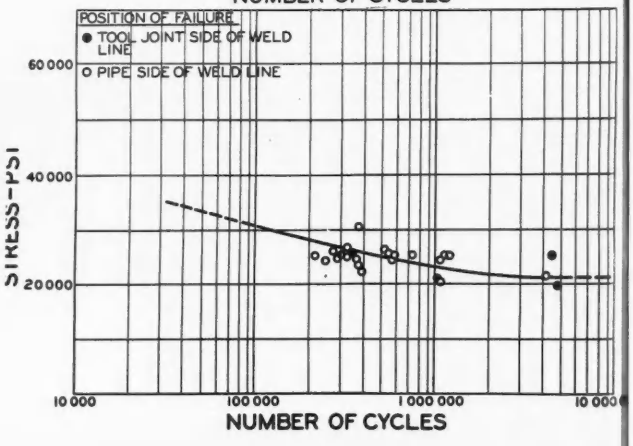


FIGURE 12-A (above). Flash-weld connection.

FIGURE 12-B (right). Fatigue curve—flash-weld connections—failures in upset adjacent to weld line.







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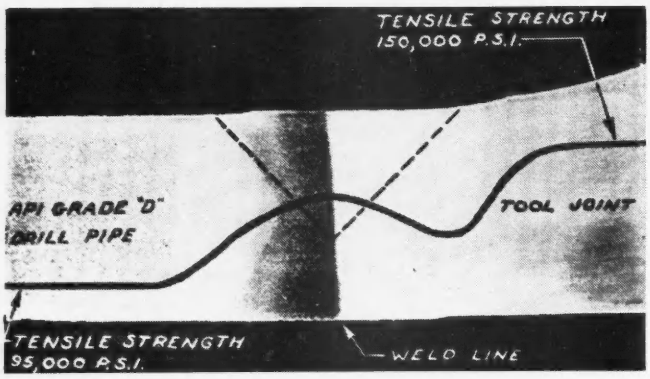

FIGURE 13-A. Tensile strength gradient in weld zone and diagram of 60-degree V-notch in flash-weld connection.

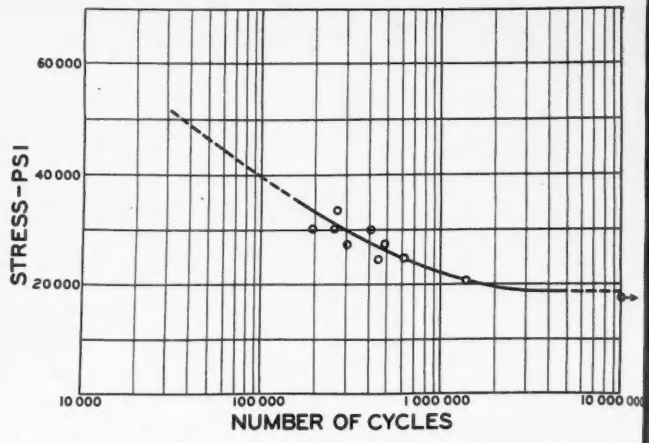

FIGURE 13-B. Flash-weld connection. Failures in V-notch at weld line

using the general form of other curves of this size section that have failed on longer runs, a reasonable stress value for the normal fatigue curve at 1 million cycles is 15,000 psi.

2. Vanishing Thread Connections (Figure 6-A). There have been several attempts to reduce the notch effect present in the API connection by using the various types of vanishing thread designs. The designs shown in Figure 6-A are the true vanishing thread and the modified types which utilize a thread relief at the last engaged thread.

Of the types shown, the true vanishing thread has the highest fatigue stress. On Figure 6-B the few scattered tests available indicate the pipe would fail at the last engaged thread at a stress of 15,000 to 19,000 psi at 1 million cycles; however, there are not enough tests on any one type to try to establish a definite fatigue limit.

THREADED PIPE-END CONNECTIONS WITH WELDED END: 1. Regular API Connections with Welded End. Drilling contractors in the field first started the practice of welding the ends of the tool joints to the pipe. The first welds were built-up bands of metal one to two inches long at the ends of the joints. This was often done by using a copper sleeve around the end of the joint and filling the space between sleeve and pipe with a band of metal.

Following these field welded joints, the present welded type was developed in which two beads are welded in the counterbore at the end of the tool joint and the shoulder machined after welding (Figure 7-A). This is presently known as a counterbore weld tool joint.

The weld provides support for the pipe at the end of the tool joint, reducing stress concentration at the last engaged thread. The last engagement between pipe and tool joint then becomes a square shoulder over a heavier part of the tapered pipe upset instead of a thread cut in a thinner portion of the upset. The weld also acts as a seal to prevent corrosive mud from contacting the threads.

The normal fatigue failure stress for the section of the pipe adjacent to the shoulder and weld is 20,000 psi at 1 million cycles (Figure 7-B).

To illustrate the reduction in stress concentration provided by the welded support outside the last engaged thread, Figure 8 shows an actual photo-elastic study of a regular API connection and a counterbore weld joint with a solid section outside of the last engaged thread. In this study both joints are loaded with approximately the same bending moment, and the degree of stress concentration is indicated by the number of lines present at any section. Comparison of the two photographs shows the notch effect at the last engaged thread has been practically eliminated in the weld-type joint.

THREADED PIPE-END CONNECTION WITH SUPPORTING LAND ADJACENT TO THE THREADED SECTION: These joints are classified as the bucked-on and shrink types (Figures 9-A and 10-A). It should be noted that the thread form is different in each case. The bucked-on joint is screwed on the pipe using a torsional load while the shrink type joint is heated, screwed-on, and on cooling shrinks until both threads and land tightly engage the pipe. The bucked-on joint utilizes a regular 60-degree API V pipe thread. The shrink-type has a modified Acme thread which provides clearances on the thread flanks. These clearances are necessary to allow for longitudinal shrinkage and to prevent excessive interference between the mating threads in the hot and cold positions.

1. Bucked-on Type (Figure 9-A). For the best performance it is necessary to buck the joint on the pipe using a buck-up machine where a controlled amount of torque can be applied. The bucked-on joint is not readily removable, like the shrink-type joint, because it will sometimes gall when bucked-off the pipe. The bucked-on type represents an increase in fatigue strength over the regular API joint and protection of the last engaged thread against corrosion.

As shown on Figure 9-B, the tests available on the bucked-on connection indicate that the pipe at the tool joint shoulder has a fatigue failure stress of 18,000 psi at 1 million cycles.

2. Shrink Type (Figure 10-A). This type joint supports the pipe against bending in a similar manner to the bucked-on type, and the last engaged thread is sealed against corrosion. The shrink-on joint has the additional advantage of being removable by heating the joint and quenching the pipe.

A tight fit is assured on the supporting land by designing the correct amount of interference between joint and pipe and heating to the proper temperature on installation. The interference between joint and pipe can be greater than in the case of the bucked-on type without the danger of galling the threads or lands when the joint is screwed on the pipe. This eliminates the possibility present in the bucked-on type of slight gall on the threads or land, produced during make-up, causing a local high spot between pipe and joint. Such a joint would appear to be tight on installation, but might loosen in service.

The test results available, shown on Figure 10-B, indicate that the shrink type has a fatigue stress of 20,000 psi at 1 million cycles at the tool joint shoulder which is slightly higher than the 18,000 psi failure stress on the bucked-on type. However, if both joints are equally tight at the shoulder, the stress concentration should be the same, and this difference may be a result of scatter.

WELDED-ON OR UNITIZED TOOL JOINTS: In an effort to eliminate a threaded pipe-end con-

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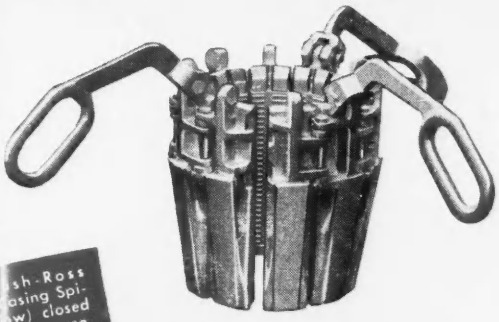

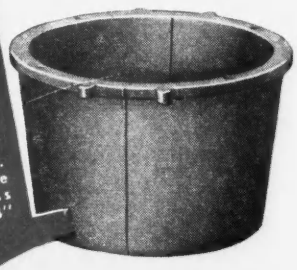

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nection and still have the physical properties of an alloy steel joint, many attempts have been made to weld the tool joints to the drill pipe.

The problem has been to get a weld consistently strong enough in fatigue strength to eliminate failures at the weld line. This problem has been solved by the flash weld type; however, the test results available on various hand weld designs are not so encouraging.

1. Hand Welded Types (Figure 11-A). The test results given in Figure 11-B are for the failures at the weld line and have been derived from more than a half-dozen different designs. These include electric-arc welds as well as acetylene welds. The arc-welded types develop slightly higher fatigue strength values. The joint as shown in Figure 11-A is typical of one of the designs tested.

In order to build up a hand weld, it is necessary to run successive beads around the joint, carefully chipping and cleaning scale from the preceding weld before a succeeding bead is run. This makes the operation lengthy, as well as hazardous in obtaining a homogeneous weld as any piece of slag will form an inclusion in the following bead.

Higher tensile strength electrodes give a higher fatigue strength on hand welds. Building up the last bead greater than the outside diameter, and machining off excess metal to clean up the surface of the joint will increase the fatigue strength. A copper back-up ring is generally used to eliminate the possibility of burning through the bore of the joint.

Figure 11-A indicates that hand-welded joints can be expected to have fatigue failure stress of 15,000 psi at 1 million cycles at the weld line. However, the scatter band for any of the types of hand-welded construction is so wide that the reliability of this figure is questionable. For this reason, there have been no attempts made in this paper to separate the various hand welded types.

2. Flash Weld Type (Figure 12-A). In principle flash welding consists of melting two pieces of metal by electric arcing, at the point at which the weld is to be made, and squeezing these two pieces together in the molten state.

In the case of flash welded tool joints, the joint and pipe are held in alignment in a flash welding machine and a high current applied. This causes arcing across the ends of the tool joint and pipe and subsequent melting of the metal in this area. The current is then stopped, and the joint and pipe are forced together thus squeezing out the excess molten metal at the weld line. The metal squeezed out is machined off to clean up the welded section.

In fatigue testing flash welded joints, where the test is set up to produce failures at the joints, the failures will always occur in the upset area adjacent to the weld line, but never actually in the weld. As illustrated by Figure 13-A, the area on either side of the weld line has a slightly lower tensile strength than the weld line itself. This probably accounts for the higher fatigue strength on the weld line.

Figure 12-B shows that the upset area adjacent to the weld has a fatigue failure stress of 23,000 psi at 1 million cycles. This is a higher fatigue failure stress than obtained on any of the other types of connections tested.

Another interesting observation from the data available shows that the fatigue stress is approximately the same, regardless of whether the failure is in the pipe or tool joint side of the weld, even though one material is medium carbon steel, and the other is an alloy steel.

In order to get some idea of the magnitude of the strength of the connection at the weld line, a series of tests was run with a stress-raiser introduced to make the connection break at this point. The stress-raiser used was a sharp 60-degree notch, three-fourth-inch deep, machined in a heavy section weld (Figure 13-A). With such a notch Figure 13-B shows fatigue strength at the weld line was still 22,000 psi at 1 million cycles.

This fatigue stress indicates that the actual weld line is as strong as any other sections of the joint, even if a severe stress raiser is present.

OTHER TYPES OF TOOL JOINT CONNECTIONS: The other general types of tool joints commercially available today, are the pressure-weld joints, similar in appearance to the flash weld type, and the integral joints with pin and box threads machined directly in heavy upsets on the ends of the pipe. The writer does not have fatigue data available on these types at the present time.

From the stress data in Table 1 and the pipe upset proportions of 4½-inch API Grade D 16.60 pounds per foot internal upset drill pipe, it is interesting to determine why the API joints would many times fail in preference to the body of the pipe while the newer type joints proved satisfactory.

Table 2 shows a series of examples of bending strength calculations using the section modulus at point of failure and the nominal bending fatigue failure stress (BM = S × SM).

Table 1

Summary of Fatigue Results*

A summary of the foregoing fatigue values for pipe-to-tool joint connections at 1 million cycles is as follows:

ITEM	Nominal Stress for "Nominal Fatigue Curve"—psi.
Regular API Threaded Connection—Failure of pipe at last engaged thread	15,000
Vanishing Thread Types—Failure of pipe at least engaged thread	15,000–19,000
Regular API Threaded Connection with Welded end—Failure of pipe at tool joint shoulder	20,000
Threaded Connection with Supporting Land adjacent to Threaded Section—Failure in pipe at tool joint shoulder.	
Bucked on Type	18,000
Shrink-Type	20,000
Hand Welded Joints—Acetylene and Arc-Welded—Failures in Weld	15,000
Flash Welded Joints—Failures in Upset adjacent to Weld	23,000
Failures in weld line with 60° "V" notch	22,000

*It should be remembered in using this table that the bending moment determines the strength of the joint, not the fatigue failure stress alone. Although the connections have a lower fatigue stress than the body of the pipe, most of the joints are actually stronger than the pipe, because of the additional section in the pipe upset.

BIBLIOGRAPHY

[1] Battelle Memorial Institute Staff, "Prevention of Fatigue of Metals." John G. Wiley Co., 1941.

[2] Evans, D. A. "Performance Requirements of Drill Pipe," Drilling Magazine, Vol. 2, No. 5, (March) 1950.

[3] Fletcher, H. W. "Drill Stem." API Dril. & Prod. Prac. 1935. Also, The Oil Weekly, Vol. 77, No. 10, p. 33 (May 20) 1935.

[4] Graham, H. W. "Development of Rotary Drill Pipe." API Dril. & Prod. Prac. 1935.

[5] Grant, R. S. and Texter, H. G. "Causes and Prevention of Drill Pipe and Tool Joint Troubles" API Dril. & Prod. Prac., 1941. Also, The Oil Weekly, Vol. 103, Nos. 10, 11, 12. (Nov. 10, 17, 24) 1941. Also, revised, World Oil, Vol. 128, Nos. 6, 7, 8, (Oct., Nov., Dec.) 1948 and Nos. 9, 10, 12 (Jan., Feb. 1, Mar.) 1949.

[6] Jackson, L. R., Banta, H. M. and McMaster, R. C. "Investigation of Causes of Drill Pipe Failures in the Permian Basin." The Drilling Contractor, Vol. 2, No. 3, (May 15) 1946.

[7] Jackson, L. R., Banta, H. N. and McMaster, R. C. "Laboratory Corrosion-Fatigue Tests of Steels." The Drilling Contractor, Vol. 3, No. 1 (Nov. 15) 1946.

[8] Jackson, L. R., Banta, H. M. and McMaster, R. C. "Battelle Reports on Field Survey" The Drilling Contractor Vol. 3, No. 3 (Apr. 15) 1947.

[9] McMaster, R. C. "An Investigation of the Possibilities of Organic Coatings for the Prevention of Premature Corrosion-Fatigue Failures in Steel." Proceedings, ASTM. Vol. 48, 1948. Discussion of paper by Bowden, R. C.

[10] Speller, F. N. "Corrosion Fatigue of Drill Pipe" API Dril. & Prod. Prac. 1935. Also The Oil Weekly, Vol. 72, No. 3 (Jan. 1) 1934.

[11] Woods, G. W. and Grant, R. S. "Arc Welding." Prize paper from Lincoln Foundation Arc Welding Contest, 1938.

Table 2

Sample Problems*

I.	Pipe Strength	
	$BM_1 = 27{,}000 \times 4.25$ (Normal Fatigue Limit)	115,000 lb.-ins.
	$BM_2 = 32{,}500 \times 4.25$ (Best Run to be Expected)	138,000 lb.-ins.
II.	Connection Strength	
	1. API Standard $BM = 15{,}000 \times 6.65$	99,700 lb.-ins.
	2. Vanishing Thread Designs $BM = 15{,}000 \times 7.20$	108,000 lb.-ins
	$19{,}000 \times 7.20$	137,000 lb.-ins.
	3. Counterbore Weld $BM = 20{,}000 \times 7.47$	149,000 lb.-ins.
	4. Bucked-on Threaded Connection with Land $BM = 18{,}000 \times 7.87$	142,000 lb.-ins.
	5. Shrink-on Threaded Connection with Land $BM = 20{,}000 \times 8.11$	162,500 lb.-ins.
	6. Hand Welded $BM = 15{,}000 \times 7.98$	120,000 lb.-ins.
	7. Flashweld $BM = 23{,}000 \times 7.98$	184,000 lb.-ins.

*The section moduli in Table 2 are average minimum values for pipe ends used by one manufacturer. The value may vary slightly with different manufacturers using special pipe upsets, but generally these values agree with most constructions.

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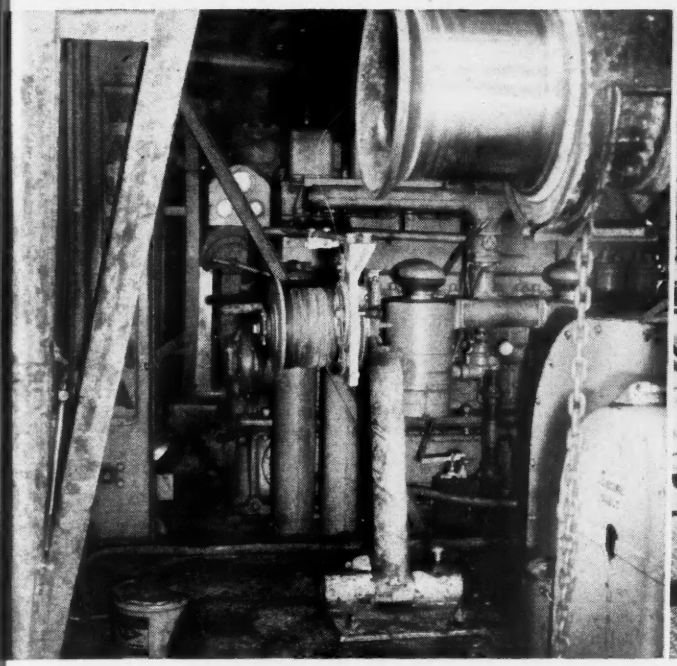

FIGURE 1. This reel mounting rotates inside two six-inch long sleeves welded to a base plate bolted to the floor. The reel is swung forward while the belt is looped over the cathead, then pulled back to tighten it.

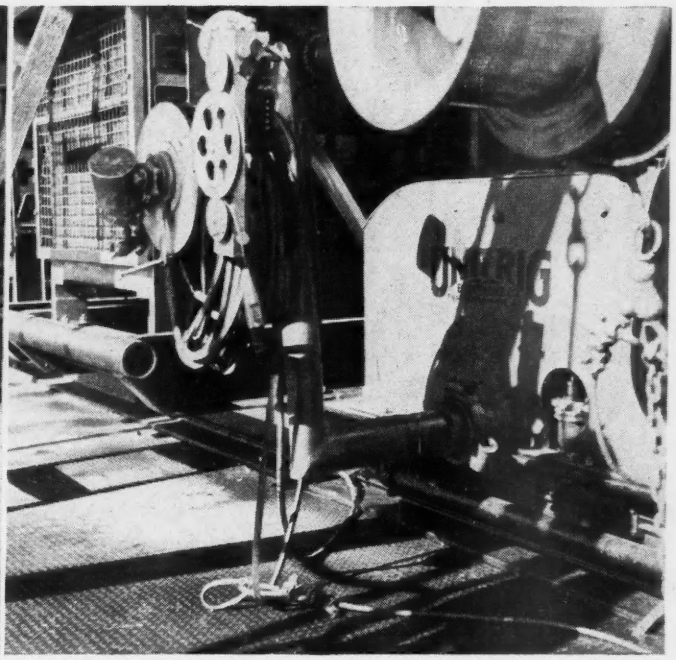

FIGURE 2. The reel mounting shown here is welded to the drawworks base and is equipped with a single large union which can be loosened to allow the reel to be swung forward or back when the belt is installed.

Adjustable Measuring Line Supports

By GILBERT M. WILSON
Pacific Coast District Editor

ON MANY rigs it is a common practice to drive the measuring line reel with a V-belt take-off from the cathead. This requires that the reel be mounted in such a way that the unit can be brought up reasonably close to the cathead for installation of the belt and can be swung back to tighten it.

In addition, it is desirable that the mount be as small and compact as possible so as to be out of the way of regular travel and to take up a minimum of floor space. Of necessity, shifting of the unit should require a minimum of time and effort inasmuch as drilling operations generally are at a standstill while the drift indicator or other instruments are being readied and run in the hole on the wire line. Two types of reel mounting installations which are of efficient design and which combine ease and efficiency of operation, are illustrated. Each has the desirable features of being movable with a minimum of effort and time consumed and being generally out of the way when not in use, and each is thus ideally suited for the portable jackknife type of rig where floor space is an important consideration.

The unit illustrated in Figure 1 is mounted on a heavy steel plate bolted to the floor and is designed to permit moving the reel forward while the belt is installed, being moved back and locked in position while the unit is in operation. The reel is bolted to a section of heavy angle material which, in turn, is welded to the top of an upright, 28-inch length of 4½-inch drill pipe. To the bottom of this upright is welded a short pipe cross bar, the latter being machined to fit inside two 6-inch sleeves of 4½-inch drill pipe welded to the edge of the 9/16-inch flat steel floor plate. Over a hole burned through the top surface of one of the sleeves a three-fourth-inch nut was welded in place and a short bolt of the same size fitted into it. A hook, fashioned from a piece of steel plate, is welded to the side of the upright standard, near the top and on the side opposite that on which the reel is mounted.

To operate the unit, the reel stand is swung forward, the belt looped over the cathead, then brought back sufficiently to tighten the belt. The three-fourth-inch bolt in the mounting sleeve at the base then is securely tightened down and a short length of chain, kept in the immediate vicinity, then is looped over the reel hook and the other end secured to any sturdy support behind the reel unit. This type of mounting combines sturdiness with simplicity of operation and, whenever necessary, can be removed merely by unbolting the floor plate and lifting the unit out with a catline.

The other type of installation referred to and illustrated in Figure 2 employs a slightly different method of mounting. In this case, the reel support, attached to a vertical member as in the previously-described installation, is mounted on a horizontal pipe arm which is welded to the base and side of the drawworks. To permit the unit to be swung forward and back when the belt is installed, a large quick-acting type union is installed in the horizontal run of the mounting. With this arrangement it is the work of but a few minutes to loosen the union, swing the unit as desired and re-tighten the union. Among the desirable features of this unit are the ease with which it can be disconnected and removed and the fact that, being mounted a foot or so above the floor, it does not interfere with cleaning or hosing down the floor.

The simplified handling, installation and disassembly of these two types of reel mountings contribute materially toward the over-all efficiency of the drilling operations and more than repay the slight amount of extra cost that may be involved in the construction of the improved mountings.

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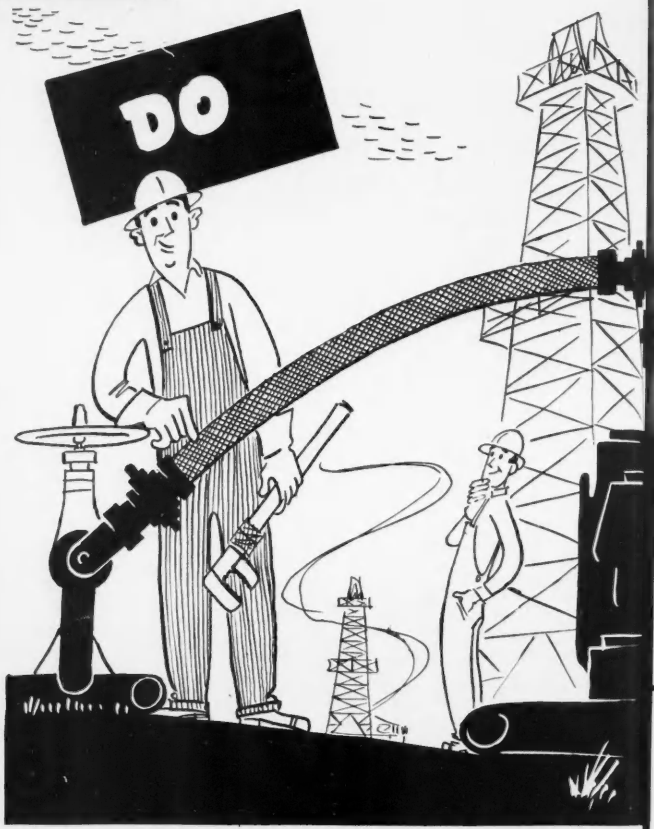

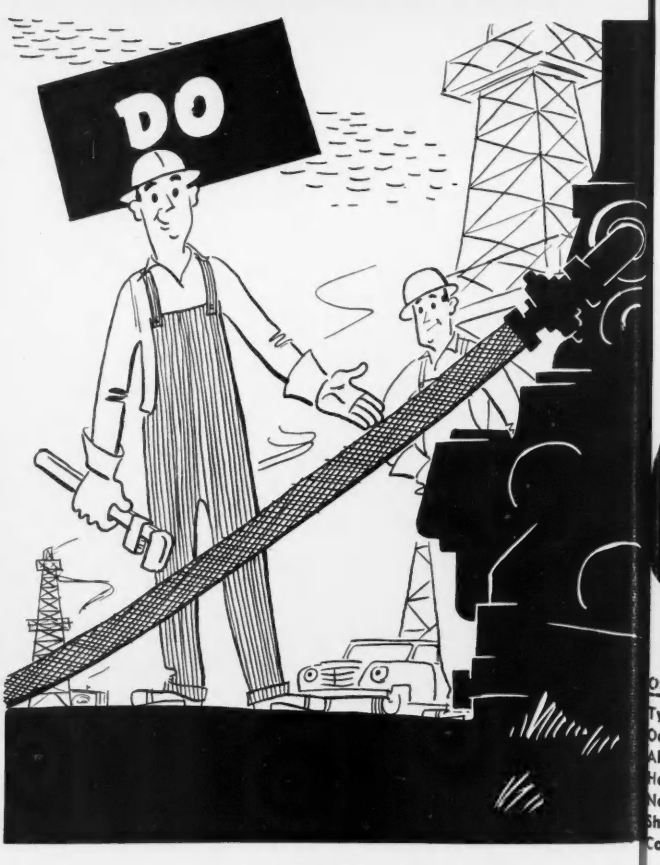

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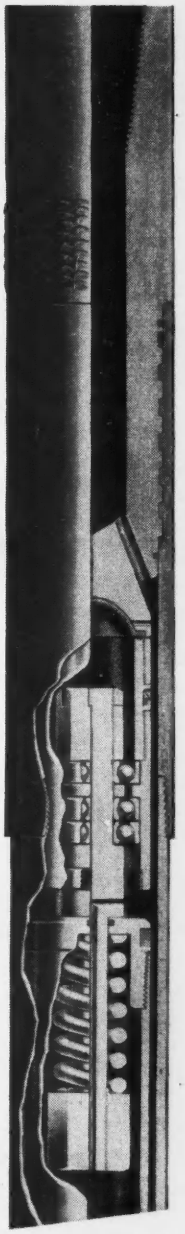

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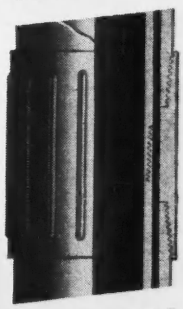

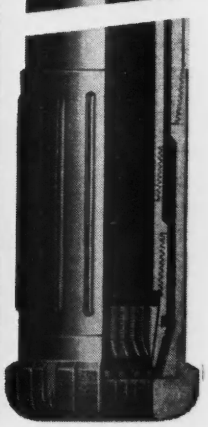

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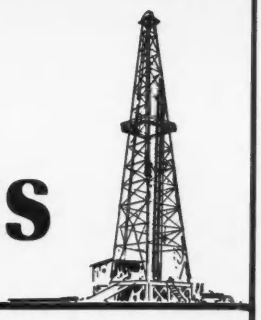

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HOW TO—Guard Flexible Suction Hose in Transit

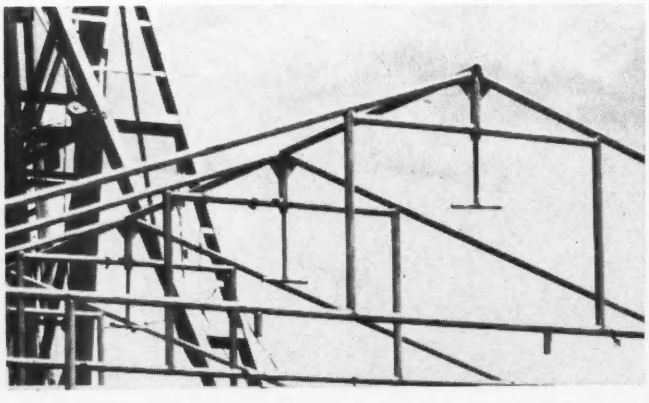
It is well known that flexible hoses of all descriptions suffer greater damage in transit from location to location than in operational service. Much damage thus imparted to the hose is caused by abnormal bends and kinks in loading and unloading operations. Such is often the case with the flexible hose attached to the mud pump suctions which makes possible easy adjustments of suction intake.

The device illustrated is a suction hose stiffener which prevents kinks or bends in the large-diameter hose when moving it from well to well. It consists of a 12-foot section of 2½-inch pipe equipped at either end with stud bolts that pass through the pipe. This stiffener is inserted through three-inch collars welded to the suction line on one end and to the short nipple attached to the hammer union on the other.

These nipples are welded to angle iron pieces or half sections of nipples, or other means may be used to elevate the sup porting collar off the suction pipe. Th elevation is necessary to provide clearanc for the stiffening member to pass over th hose which is clamped securely to the suc tion line. The stiffener eliminates the jo of removing the clamps and taking off th rubber hose, which job itself is time con suming and may result in stretching th diameter of the hose beyond use, since must be air-tight.

In preparing the suction line for moving the bolt at the left end of the stiffenin pipe is removed, and the pipe inserted i the supporting collar shown at left. Th bolt is replaced to prevent the 2½-inc pipe from slipping out of the collar. Tw such collars on the main section of the lin provide a rigid alignment and give th necessary support to protect the hose i shipment.

HOW TO—Take Up Slack in Canvas Engine Roofing



When canvas is used as a roof over drilling engines and drawworks, it usually stretches with age, and will, unless provisions are made to take up slack, form large pockets in which rain water may accumulate and possibly tear the canvas. To eliminate such nuisances where tubular framing is used to support the canvas roof, a simple screw jack device may be used to compensate for any stretch due to use, age and the elements.

Each roof supporting frame is a tubular truss that spans the entire platform surrounding the engines and drawworks. Four such trusses are used. End frames are supported by four uprights, with the middle two frames supported only on each end. A box-like frame is added, as shown, to give vertical support to the roof truss an provide a frame for the screw jack devic

A short vertical section of pipe is welde to the apex of the truss and extended t the short horizontal member as show The two-inch ridge pipe rests in the ape of each truss in a saddle pad attached a long rod extending through the sho vertical pipe. The lower half of this ro is threaded and passed through a nu welded to the bottom of the pipe throug which it passes. This threaded rod exten downward about a foot and has a handl at the end for rotating. The ridge po can be raised by feeding the threaded ro up through the nut, and can be loosen by reversing rotation. This simple devic makes it easy to tighten the roof canva

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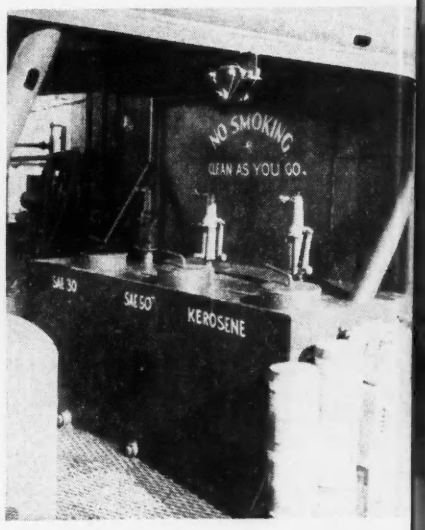
HOW TO—Handle Lube Oil Supply

A distinct improvement over the usual methods of handling individual drums of lubricating oil, kerosine and similar products at the drilling rig is seen in the neat installation employed by one drilling contractor operating in West Texas. Occupying a small area in the rig substructure where it is partially protected from rain and dust, the installation is easy to maintain and keep in a condition that presents a minimum fire hazard.

The principal feature, one which greatly facilitates the handling of full oil drums, is the small overhead track and trolley which extends the length of the walkway area. Using light block and tackle, the full drum is elevated to the desired height, then emptied. Each reservoir has an unusually large circular opening, and a quick-closing, sealing-type lid, permitting oil to be poured with a minimum of spillage. A hand pump for filling smaller containers is provided for each reservoir. An easily accessible drain plug is located at the front, bottom of each of the containers.

Constructed as simply as possible, the all-welded unit has few hard-to-get-at corners in which waste oil and dust could accumulate and because of its ease of cleaning, crew men are encouraged to exercise care in handling of the oil supplies. Moved as a complete unit with the substructure, the installation always is available whenever needed and reduces considerably the amount of work usually entailed in the handling and moving of individual drums and racks commonly stored in the open area beside the rig.



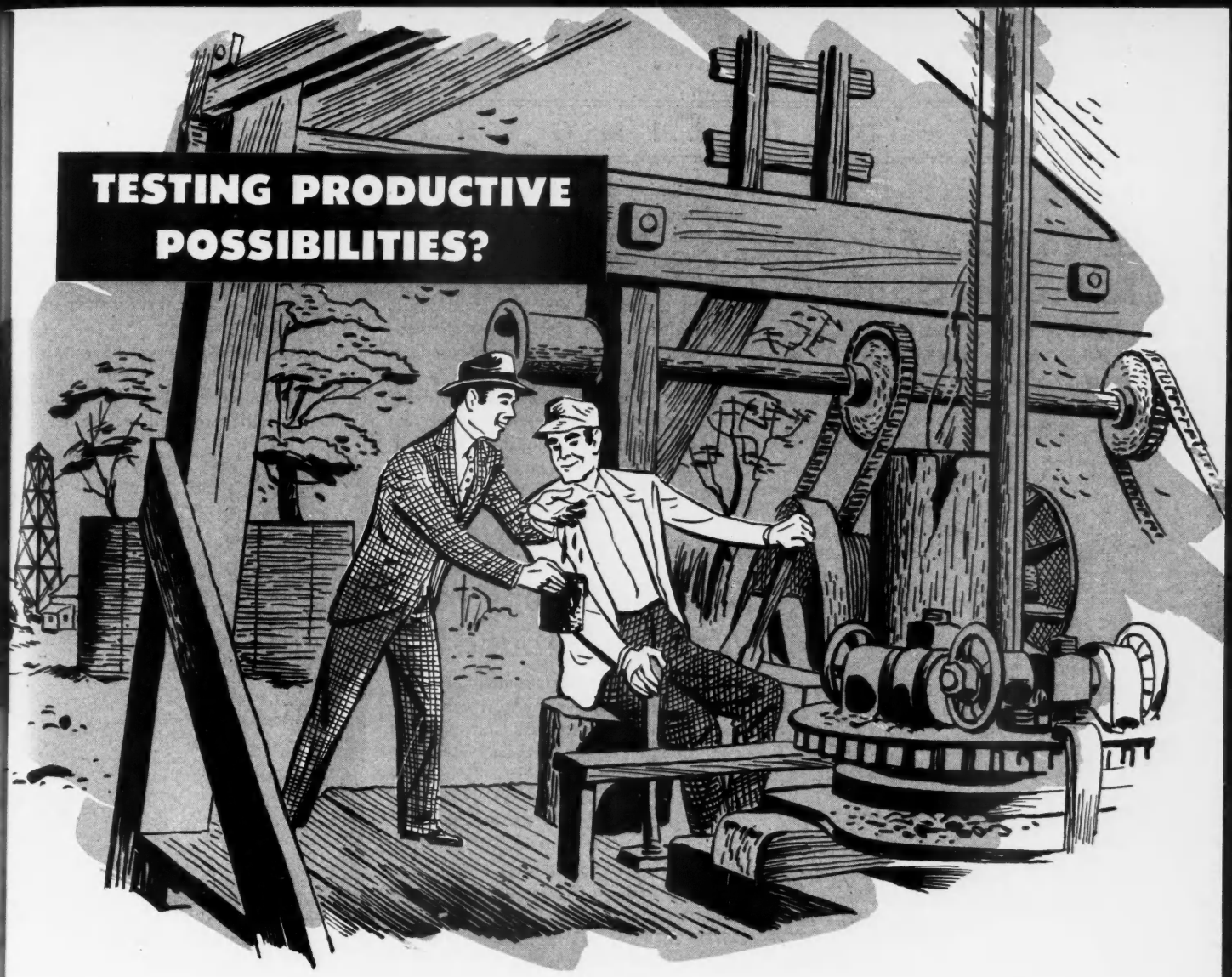
HOW TO—Unitize Casing and Bit

Because of the length of the kelly, its cost and the necessity for keeping it absolutely straight, many operators encase the kelly in a scabbard, usually made from a joint of range 3 casing. The upper shoulder of the scabbard is fitted with a collar into which the top of the kelly can be screwed.

Here is an idea that not only makes it possible to anchor the kelly at the bottom, but unitizes the casing with a shop-made fishtail bit that is used to drill the rathole. The bottom of the casing scabbard is swaged down to fit around the outside diameter of a 4½-inch tool joint which has been taken out of service. The tool joint is inserted in the bottom of the scabbard with the box end placed inside the casing. The tool joint is then welded to the scabbard.

A piece of ½-inch plate steel cut to fit over the pin end and designed to resemble a fishtail bit is welded in place as shown. The blades are shaped and sharpened to provide cutting edges.

In drilling the rathole, the kelly is left screwed in place and the swivel may be attached so that the pumps can be used to flush out the cuttings and to jet the hole if possible. In this manner, the scabbard can be rotated and fluid pumped through the tool joint welded to the casing. After the rathole has been dug, the scabbard is left in place so that the kelly and swivel may be stabbed during round trips.



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Guide Rotary Hose To Prevent Scuffs

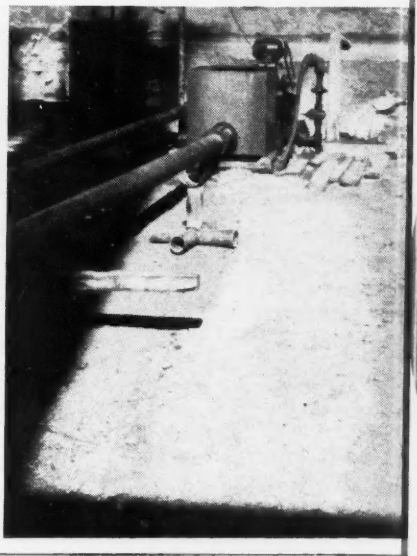
A method of tying back the rotary hose, one which can be rigged quickly in an emergency when other materials may not be available at the time, may be seen in the installation shown in the accompanying photograph. Intended to prevent the hose from scuffing against the side of the rig or other equipment, this device consists of a short piece of chain on which has been threaded a series of eight short nipples of two-inch pipe. These nipples, cut so as to leave no burrs or sharp edges exposed on the ends which might injure the hose, roll with the hose as it travels, permitting movement without the occurrence of undesirable scuffing. A small sheave attached to the end of the chain loop rides up and down a sand line guide at the corner of the derrick.

HOW TO—

Make Inexpensive Walkway Around Rig

During rainy periods it sometimes is difficult, because of heavy mud or puddles of water, for workmen to walk from point to point around the rig location. One crew of a rig operating in the West Texas area has found it desirable to make narrow "sidewalks" using surplus or otherwise wasted cement that sometimes is available following rigging-up operations or after a cementing job. No effort is made to build forms or maintain a consistent thickne efforts being confined solely to making slightly-raised, dry walkway along wh a man may walk without difficulty. Ill trated is one example of this type of wa way which leads from the rig floor out the shale shaker and pits.

An advantage of this type of walk is fact that it is easily broken up and sho off by the bulldozer when the location cleaned up following well completion.



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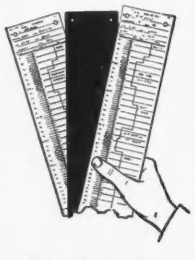

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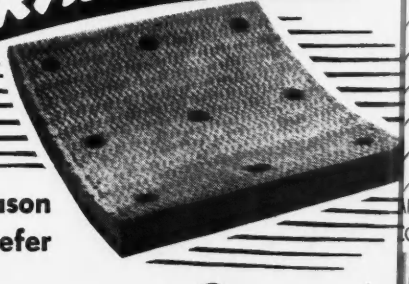

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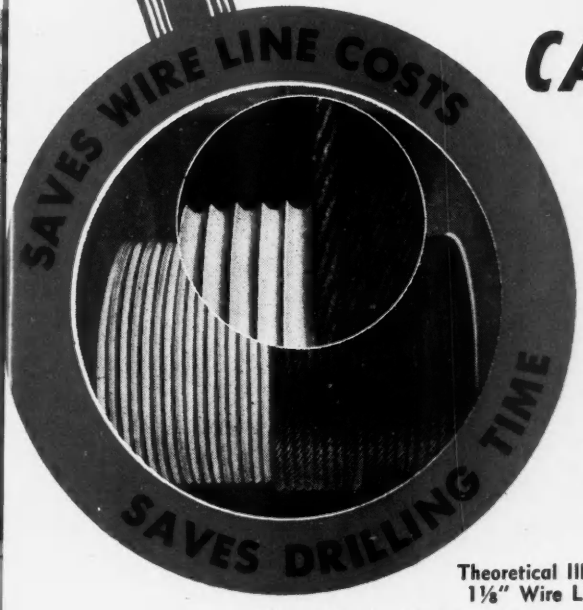
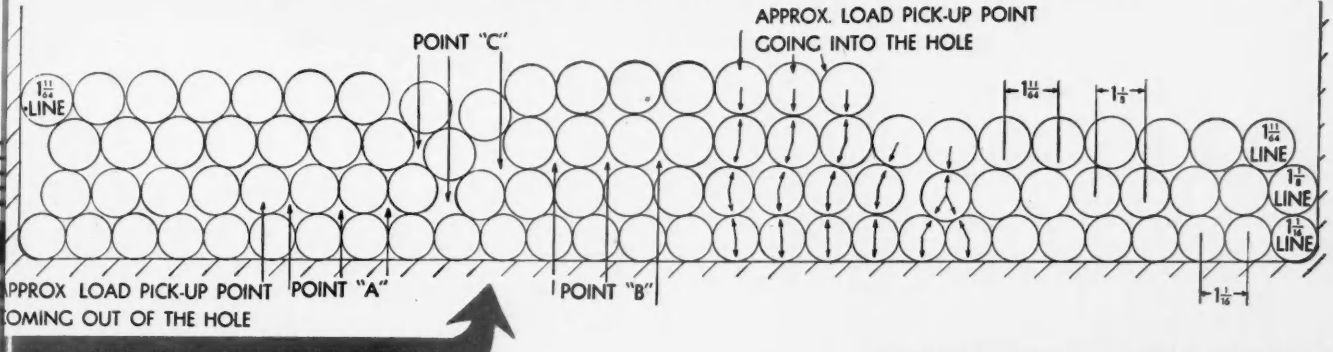
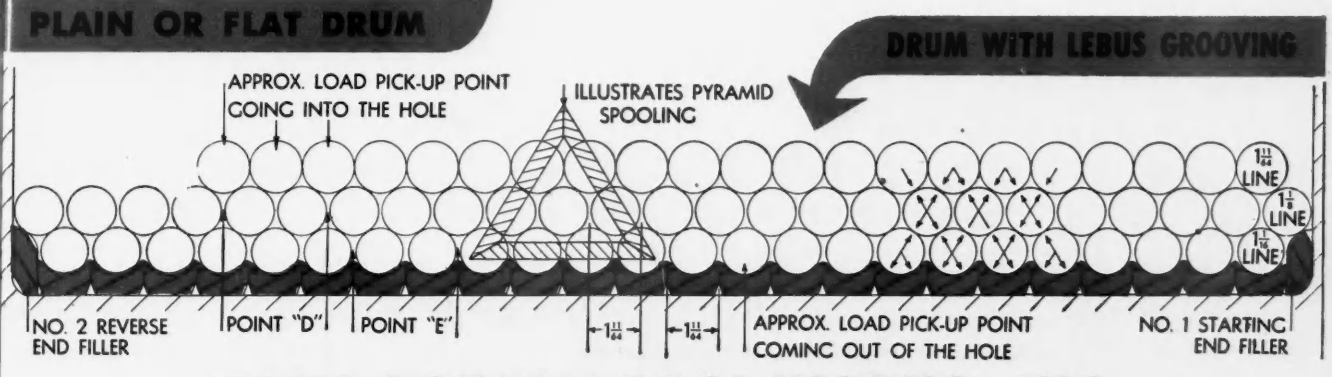


The LeBus Wire Line Grooving and Spooling System has been engineered and developed to meet an urgent requirement to cut the costs and improve the performance of wire line. Pinching, Squeezing, Crowding and Mis-shaping of Wire Line is indicated by crooked arrows on *the Cross-Sectional drawing of the Flat or Plain drum below.* Flat Drum spooling is wasteful to Wire Line and hazardous to the Drilling Crew. These Wire Line Troubles are remedied when your Drum is grooved with LeBus Grooving and End Fillers *as shown below on the cross sectional drawing of a grooved drum.* Even a tapered or distorted line spools evenly and safely on a grooved drum. The loads line up as indicated by crossed arrows. The wraps "Pyramid" as shown with large triangle. This controlled contact and even loads mean longer life and safer drilling operation. The photograph and inset to the left is a drawworks drum with the LeBus Wire Line Grooving and Spooling System installed and with the first layer of line wrapped to the preferred pick-up point when coming out of the hole to change bits. It pays to look into LeBus Wire Line Grooving and Spooling—Many of the Largest Drilling Contractors have installed this system. Why? It has saved them money.

Theoretical Illustration of the Spooling of a Tapered or Stretched 1⅛" Wire Line. A.P.I. Tolerance 1⅛ + 3/64 or — 0 Diameter

This print also illustrates the comparable difference in the amount of line required on a plain drum and a grooved drum, when the pipe has been picked up to the required height for making connections.





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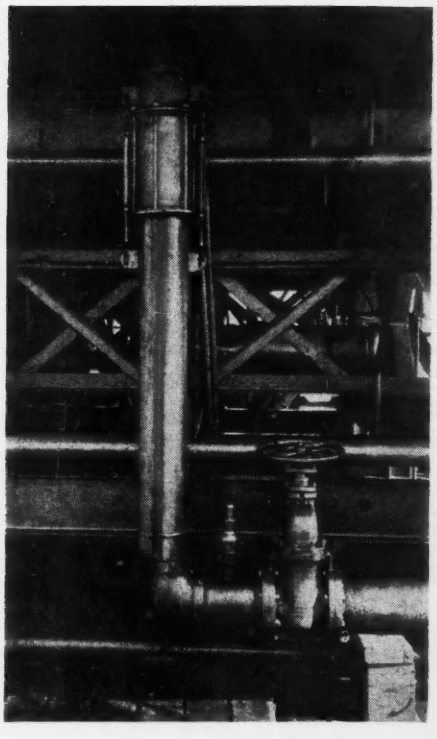
HOW TO—Add Steam Drilling Engine Exhaust Line

A quick and simple method for connecting up the steam exhaust line of a 14 x 14-inch steam drilling engine with a minimum of added fittings is illustrated. The volumes of steam consumed by the drilling engine being relative large, and because in many cases this exhaust steam is used for forced draft on the boilers, the exhaust line is usually 8 or 10 inches in diameter and is made up pressure-tight.

To facilitate hooking up the steam exhaust line and also to simplify its dis-



assembly for a rig move, this easily-made connection was installed. It consists of the usual vertical run of ten-inch line, but differs in several respects in the method of connecting to the engine exhaust manifold.

At the top of the riser a sleeve-type coupling is inserted in the line, terminating at the upper end with a short nipple that screws into an ell in the exhaust line. Because this type coupling is not designed to carry any vertical load, and because the vibration is excessive, the coupling is reinforced as shown. Side wing tabs are welded to opposite sides of the connecting pipe and holes are drilled at their outer ends. Two turnbuckles enable these lines to be drawn up inside the coupling for a good packoff, and at the same time take the vertical load of the riser.

The line is supported for the most part by a large timber block placed under the vertical section of the line containing a gate valve. When the rig is to be moved, the bolts in the coupling are loosened, the turnbuckles backed off and the block removed, allowing the riser to be lowered. The ell and short nipple in the upper end are then turned upward and out of the way for skidding the engine off the substructure and onto a truck.

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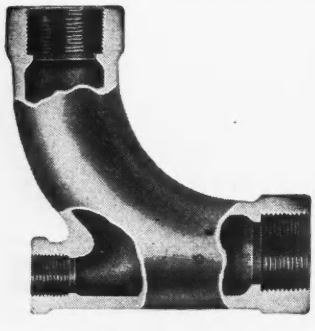

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HOW TO—Insure Radiator Cooling

In the arid areas of the Southwest where temperatures frequently reach 100° F., and where desirable cooling water for engine radiators must be hauled to the well site, a handy water trailer solves the problem of supplying adequate cooling water. The illustration shows a simple two-wheel trailer made of angle iron material bolted directly to the trailer axle. The cylindrical tank is welded to the channel-iron skids bolted to the trailer frame. An inlet at the top and to the rear of the tank and an outlet at the bottom, also at the rear, are the only openings in the tank.

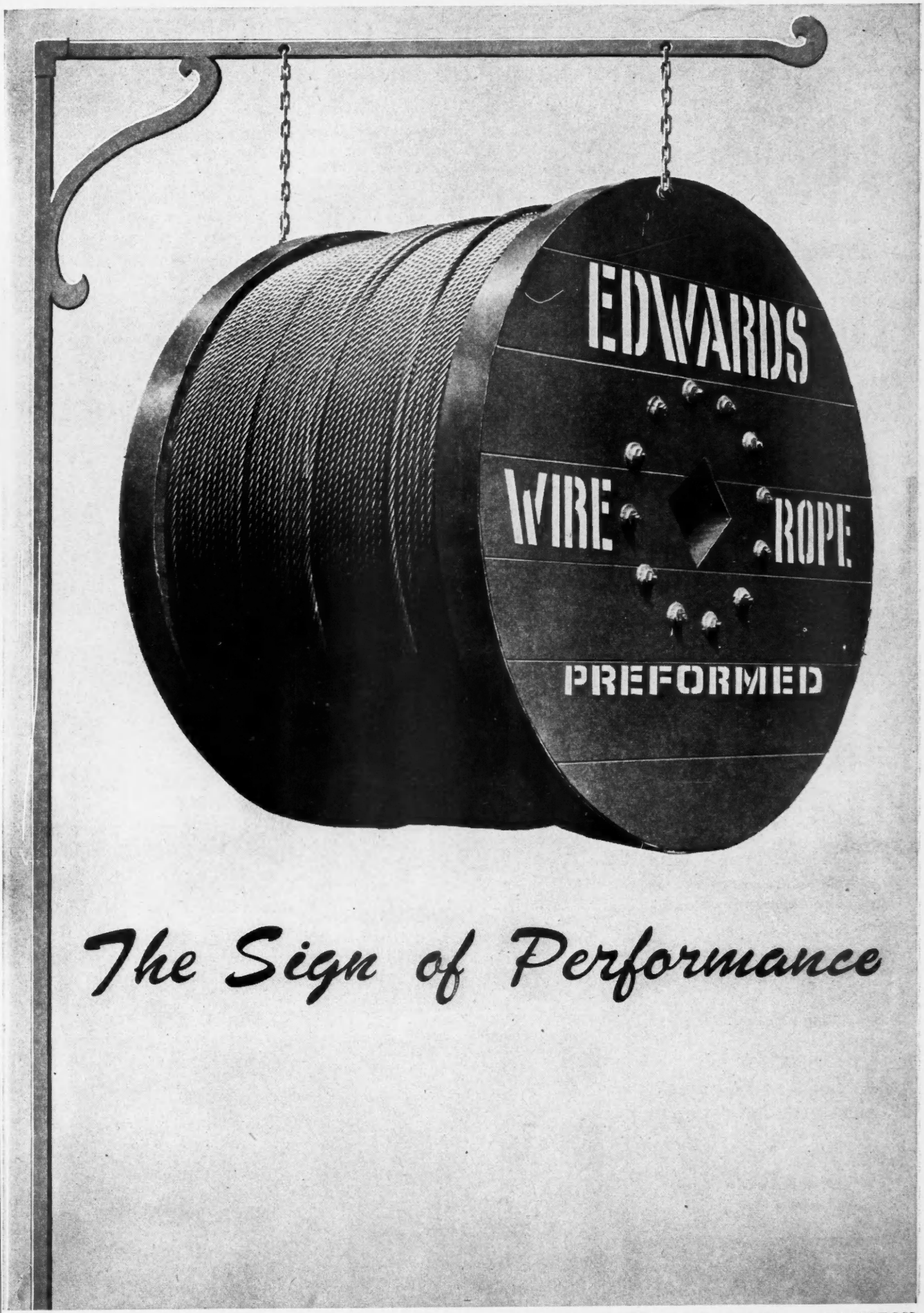
The relative scarcity of good makeup water makes it worthwhile to provide an overflow drain whereby the water can be collected and piped back into the trailer by flexible rubber hose unfit for other purposes. The lower hose has a quick-connecting coupling that attaches to the drain line on the tank. This drain line becomes the suction line for a small centrifugal pump which supplies the original fill water as well as the makeup water to take care of evaporation losses.

Considerable radiator trouble caused by use of improperly treated water is thus avoided, and the volume carried by the trailer provides insurance against running short of cooling water. The trailer is lightweight and can easily be towed by a pickup truck. The investment is small, and the trailer can be packed as shown, below the ladder leading to the derrick floor.

HOW TO—Protect Pistons and Rods

A shop-made rack of novel but practical design which goes far toward solving the problem of safely storing slush pump rods, pistons and miscellaneous parts or supplies at the well, is illustrated. The all-welded rack consists essentially of a series of four near-vertical lengths of 2½-inch pipe, in each of which a pump rod can be inserted and covered with a steel hood, and a horizontal bin in which are stored spare parts, piston rubbers, packing and small hand tools. The bin is welded to the front of the rack.

Length of the rack is approximately 44 inches, not including the several inches projection at each end of the several ¾-inch rods which connect the upright tubes and which serve to support the hoods that are placed over them. Height of the rack is approximately 44 inches from the base to the top of the row of tubes. The base, as well as the tubes, is of 2½-inch tubing material. The tubes are spaced on 14-inch centers and are inclined slightly toward the



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rear. The hoods which are placed over the tubes are made of 14-inch lengths of casing, closed at the top. They are of two diameters, two being of seven-inch and two being of nine-inch, in order to accommodate piston sizes of both large and small ranges. Slots are cut out of the sides of the hoods to permit their being slipped down several inches over the ¾-inch round bar spacers to assure that the hoods will not slip off accidentally.

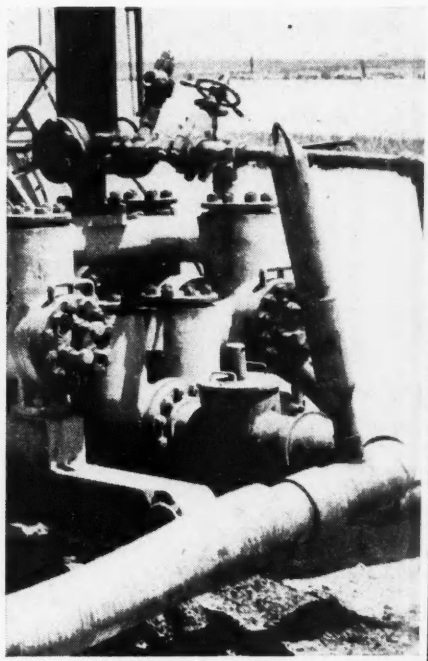
Approximately 18 inches up from the ground, on the front side of the tubes, is mounted a storage bin made of a 44-inch length of 10¾-inch casing. It is closed at both ends and is provided with a hinged cover, the latter being cut out of the piece of casing itself. The bin is supported by two short lengths of two-inch pipe at the front, and at the rear, by welding it to each of the tubes at the points of contact.

HOW TO—Trap Air in Pump Suction

When air is drawn into the suction of a power-driven mud pump operating at normal speed, a hammering action results when the piston compresses the air rather than pumps the fluid. This action is not only damaging to the pump but results in inefficient operation. In an attempt to trap any small amount of air entrained in the mud entering the suction, one contractor devised this simple air collector.

It is made of six-inch casing about three feet long, welded closed on the top end where a bail is added for easy handling. The lower end is tapered down to three inches in diameter and welded to a short three-inch nipple threaded on the bottom. A three-inch coupling is welded to the 10-inch mud pump suction as shown, and the trap attached.

The idea embodied in this device is to trap air as it travels inside the suction line connected to the pump. Air, by virtue of its specific gravity, would rise to the top of the suction line, and as it is moved toward the pump, would encounter the opening leading to the trap. This air would then enter the chamber where it would remain until the trap was disconnected. Since the volume of air normally entering the suction is small, and usually originates through small leaks in the hose connection or through entrained bubbles in the mud, a large trap need not be used.



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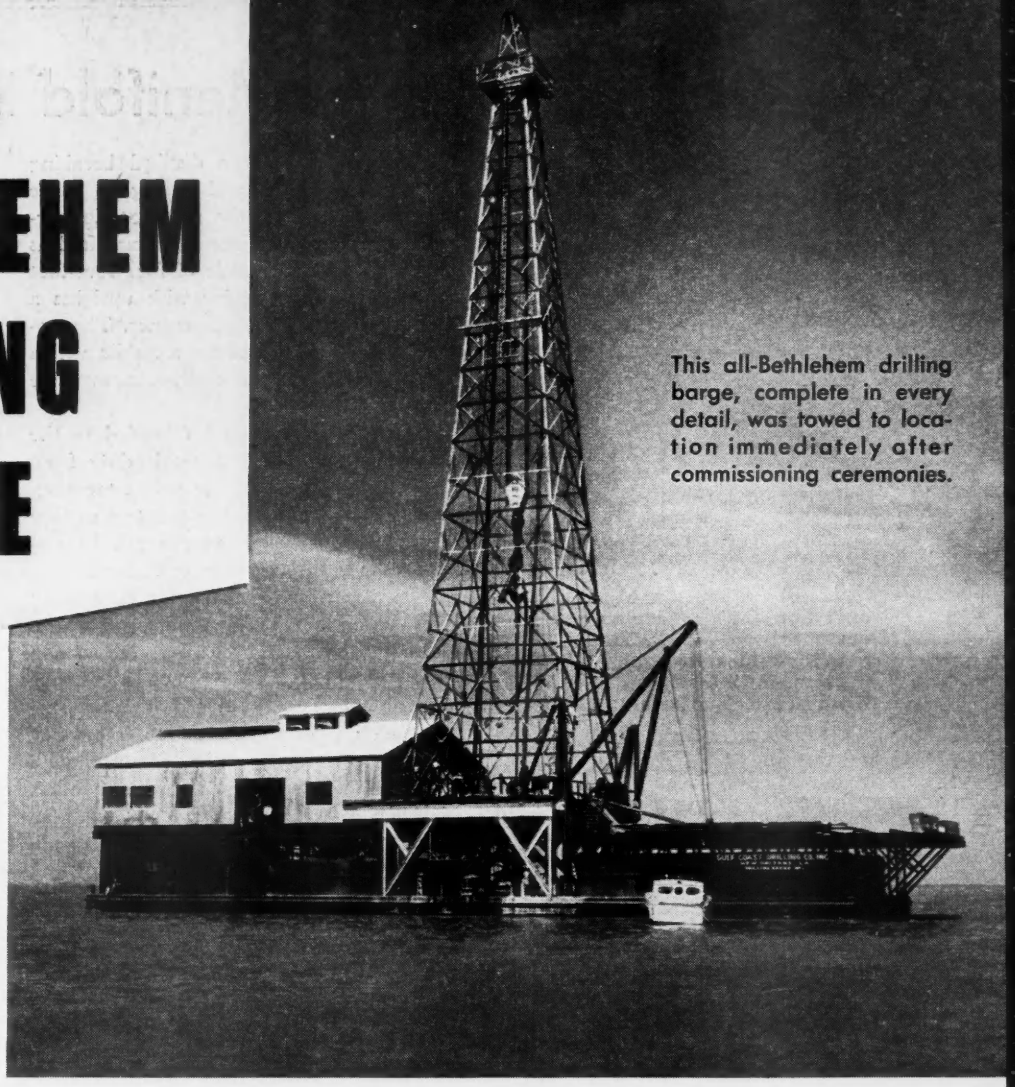

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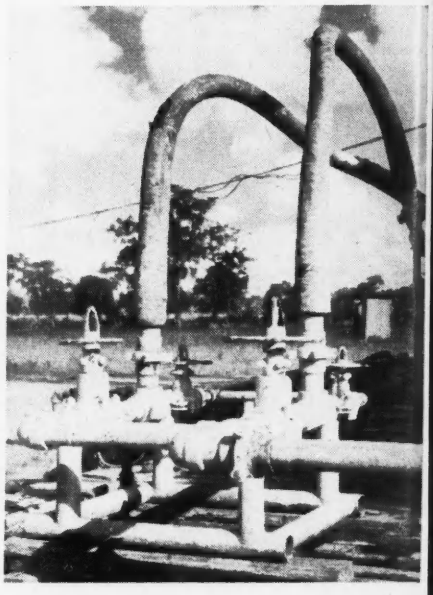
HOW TO—Manifold Pump Discharge

One contractor who disliked breaking out various unions and trying to make them match up on the next location arranged a single, skid-mounted manifold as shown. The skid is made of four four-foot pieces of three-inch pipe with uprights a foot long welded to each corner. The uprights are each topped by a saddle which holds the valves in an easily-maneuverable position.



A tee is screwed on bullheaded to the end of the discharge hoses leading from the two pumps. Mud line valves are then screwed on nipples in the two tees so that either or both of the pumps can be discharged into the drill pipe, or either or both of the pumps can be used for circulating and mixing mud or pumping clear water.

Another connection leads to the suction of the pumps so that at a moment's notice either pump can be turned into the suction of the other in case of emergency when one pump will not put up enough pressure and they must be compounded.

When it is time to tear down, one man with a hammer can break the unions leading into the manifold and the entire unit can be set up on a truck with the winch line. When the new location is reached, it is just as simple to reconnect the pumps through this manifold.

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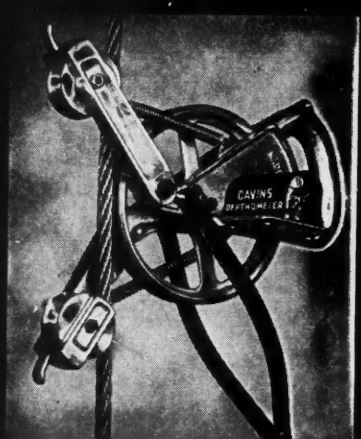

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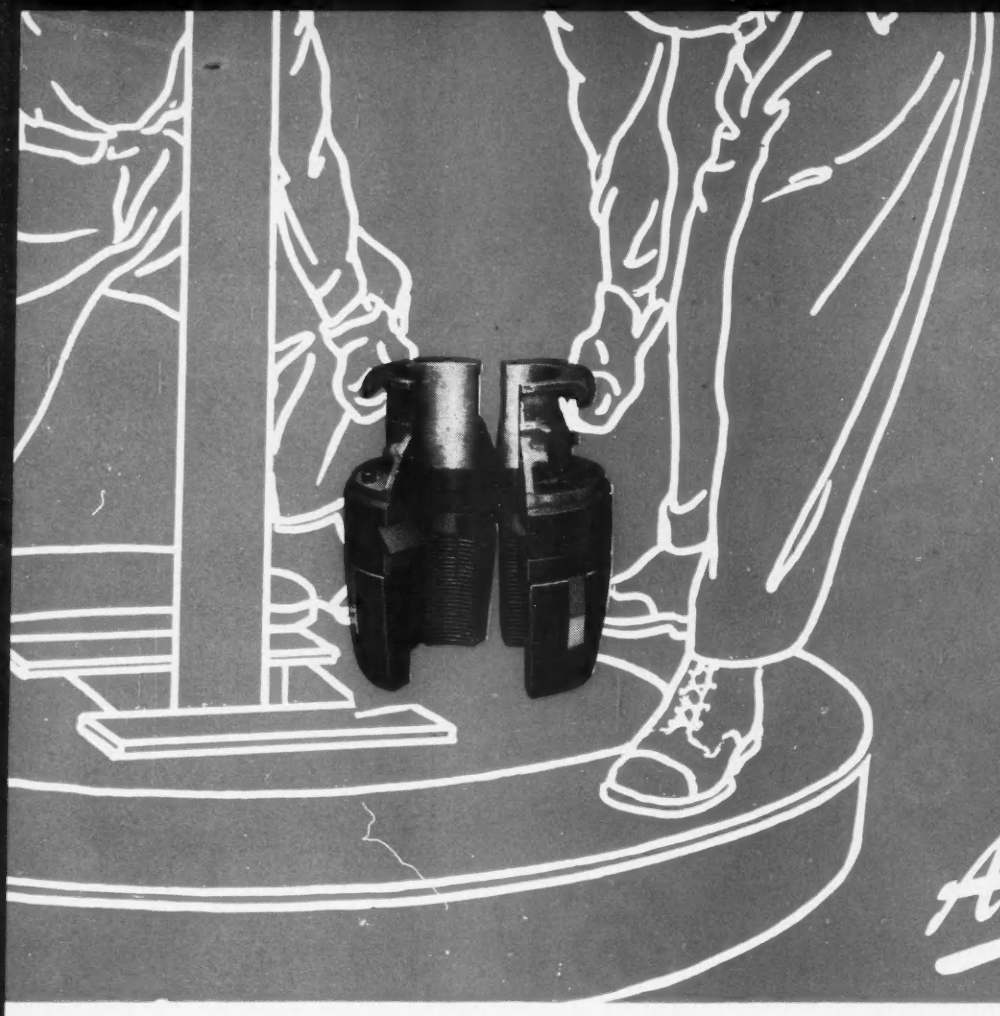

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Whether fastened to the pipe or dropped, the hanger assembly will pass through full-opening Cameron Blowout Preventers. The setting guide facilitates handling and prevents the hanger from becoming "cocked" on the pipe when it is dropped through the preventers.

The instant the hanger seats in the casing head the slips are set and a seal is effected automatically. The preventers may then be lifted without danger of a blow-out between casing strings. When the preventers are lifted, the setting guide, which has now served its purpose, may be detached and discarded. At this point the seal may be readily inspected and, if desired, the packing compression screws may be tightened.

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Wave Forces and Vertical Loading on Offshore Well Casing

By J. A. REED, II, and H. H. MEREDITH, Jr.
Humble Oil & Refining Company, Houston

THE COMPLETION of offshore oil and gas wells with conventional wellheads poses the problem of an unstable casing column. This paper presents a method for determining the allowable wellhead loading for such a column with consideration of the horizontal forces acting on a round, vertical column which would be induced by the maximum probable breaking wave under hurricane conditions. A graphical method for stress determination is shown and deflections induced in a casing column computed. This paper was presented at the Annual Meeting, Petroleum Section, American Society of Mechanical Engineers, at New Orleans.

PRESENT practice in the completion of offshore oil and gas wells provides casing and tubing suspension by conventional wellheads just under the platform, which may be more than 100 feet above the highest lateral support below the mud line. The combined action of the vertical load from normal casing weights and the horizontal load from wave forces produces a force system approaching or exceeding the ability of the column to withstand it. It is the object of this paper to present a method for determining the allowable wellhead loadings on offshore locations in water from 30 to 60 feet deep under conditions of maximum probable hurricane waves.

Design Conditions

A casing program used by Humble Oil & Refining Company is as illustrated in Figure 1. First, 26-inch casing is driven and jetted to refusal to a depth of approximately 100 feet below the ocean floor. Second, a string of 20-inch casing approximately 300 feet long is swung from the elevators and cemented to the top of the 26-inch casing; the cement in the annulus is washed out with small pipe to 20 feet below the ocean floor, and the annulus packed with pea-sized gravel. The elevators are not released until after cement has set, which leaves the 26-inch and 20-inch casing in a stress-free condition. Third, a string of 13⅜-inch casing approximately 3000 feet long is cemented at the bottom with 650 sacks and then slacked off to zero stress at the top of the fixed portion as determined by pipe stretch after cement has set. The annulus between the 13⅜-inch and the 20-inch casing is then squeezed with 450 sacks of cement which is displaced to 20 feet below the ocean floor. After this cement has set the casing is slacked off to the residual load to be carried on the 20-inch by 13⅜-inch hanger. The annulus is then packed with pea-sized gravel from the top of the cement to the top of the annulus and the hanger set. Protector casing and oil strings are set with 1000 feet of cement at the bottom of each string. Secondary support is provided, if necessary, through a down-the-hole hanger or a cement plug squeezed through the annulus. These hangers or cement plugs are placed below the top of the cement sheath inside the 26-inch casing and above the casing seat for the 20-inch casing, and loads are thus transferred through the 13⅜-inch to the 20-inch casing to the formation. The residual load applied to the 20-inch by the 13⅜-inch wellhead hanger is approximately 10,000 pounds. All loads imposed by the inner strings smaller than 13⅜-inch are carried by the 20-inch casing. The whole assembly is laterally braced to the platform and zero deflection assumed at an elevation of ten feet above Mean Gulf Level. As the ocean bottom in some parts of the Gulf is of a very fluid nature and offers little resistance to shear, the second point of fixity for the casing string is assumed to be 20 feet below the ocean floor.

The maximum probable deep water hurricane wave for the Gulf is estimated at 35 feet. Figure 2 shows the height of breaking waves in various depths of water for a maximum wave height of 35 feet in deep water. For design purposes it has been assumed that in 60 to 40 feet of water, a 32-foot breaking wave will exist and in 30 feet of water, a 24-foot breaking wave. The height of all breaking waves is assumed to be three-fourths above and one-fourth below water level.

It has also been assumed that the effective water depth will be increased by a storm tide varying according to early estimates as shown in Figure 2 from ten feet at a normal water depth

of 20 feet to negligible at 60 feet. The magnitude of storm tide has a substantial effect on allowed casinghead loads shown in Figure 5 and also on the platform elevation required to clear a hurricane wave. Recent observations on two platforms approximately eight miles from shore in 40 to 45 feet of water after the hurricane of October 3, 1949, indicate that this storm tide estimate may be low, and has had a serious effect on platform and casinghead load design considerations. Humble is now assuming a ten-foot storm tide at all well sites and a 40-foot breaking wave in water depths greater than 40 feet in the design of future platforms.

The forces imposed by breaking waves have been predicted by several different theories. Munk has developed a conservative compromise employed by Humble, using the Solitary wave theory[1] modified by the Airy wave theory.[2] Maximum forces occur at the crest of breaking waves.

A plot of the horizontal force distribution, computed by Munk's theories, developed by a 32-foot breaking wave, along a 26-inch column in 40-foot normal water depth plus a five-foot storm tide is shown in Figure 3. The Airy wave theory gives greater forces than the Solitary wave theory from the ocean floor to a point above halfway between mean water level and the wave crest. Above that point the Solitary wave theory curve is greater. While the Airy and Solitary wave theories have been known for many years, neither has been positively validated for breaking waves. Therefore, in this investigation the theory is used which gives the greater unit force at any particular elevation.

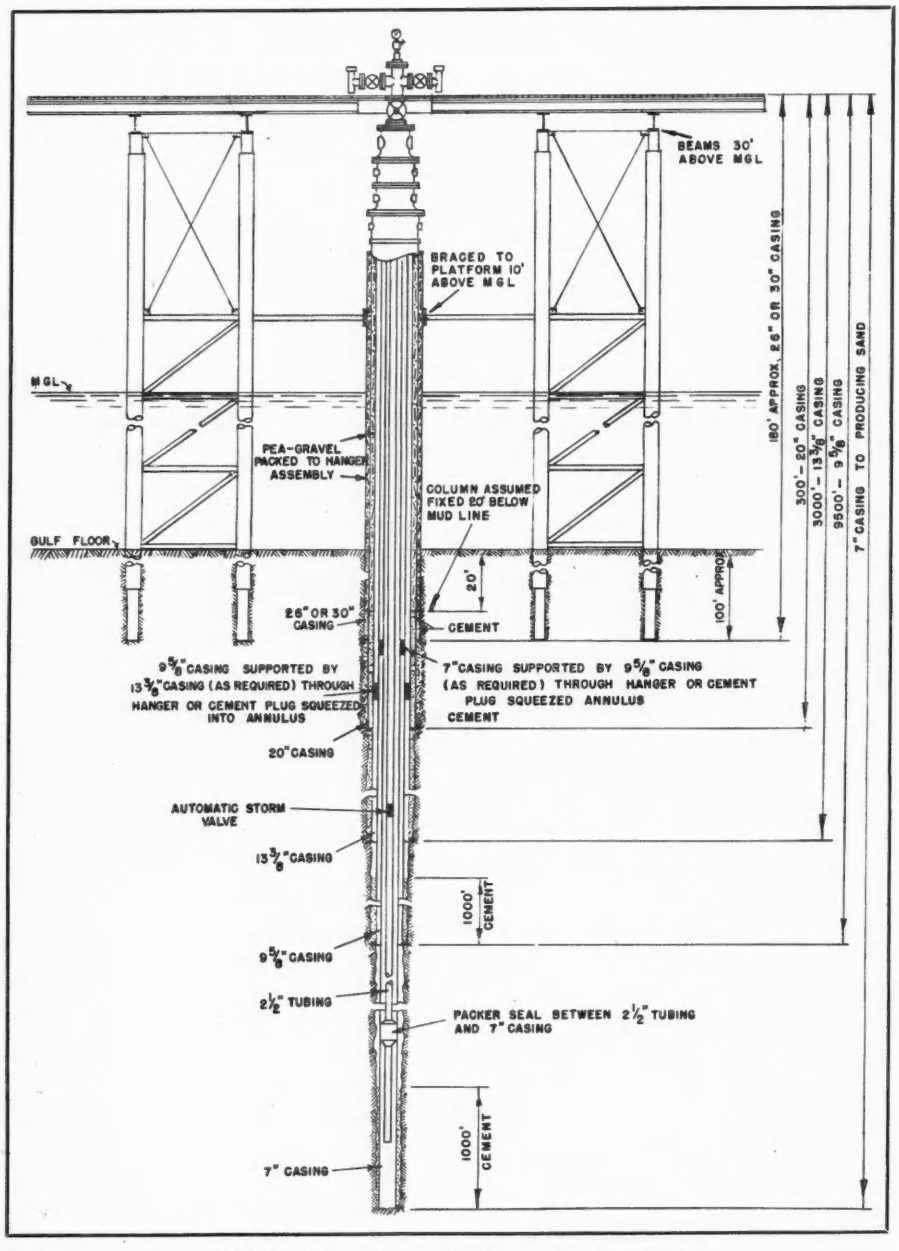

BEAMS 30' ABOVE MGL
BRACED TO PLATFORM 10' ABOVE MGL
MGL
PEA-GRAVEL PACKED TO HANGER ASSEMBLY
COLUMN ASSUMED FIXED 20' BELOW MUD LINE
GULF FLOOR
180' APPROX. 26" OR 30" CASING
300'- 20" CASING
3000'- 13 3/8" CASING
9500'- 9 5/8" CASING
7" CASING TO PRODUCING SAND
20'
100' APPROX.
26" OR 30" CASING
CEMENT
9 5/8" CASING SUPPORTED BY 13 3/8" CASING (AS REQUIRED) THROUGH HANGER OR CEMENT PLUG SQUEEZED INTO ANNULUS
7" CASING SUPPORTED BY 9 5/8" CASING (AS REQUIRED) THROUGH HANGER OR CEMENT PLUG SQUEEZED ANNULUS CEMENT
20" CASING
AUTOMATIC STORM VALVE
13 3/8" CASING
1000' CEMENT
9 5/8" CASING
2 1/2" TUBING
PACKER SEAL BETWEEN 2 1/2" TUBING AND 7" CASING
1000' CEMENT
7" CASING

FIGURE 1. Typical Completed Offshore Oil or Gas Well.

Solution of the Problem

The casing column under the action of wave forces and as supported is a continuous beam with statically indeterminate stresses and therefore involves the theories of elasticity for solution of the reaction at the lateral support, the moment distribution, and the deflection curve. This was done by determining the deflection at the point of lateral support ten feet above mean Gulf level as if that support were not there and then computing the lateral force required to reduce the deflection to zero at the point of lateral support. A graphical method was employed. The final result, showing the moment distribution and the deflection curve produced by wave forces for conditions at 40 feet mean Gulf depth is shown in Figure 4.

Next the allowable axial load on the casinghead was determined from the following relation

$$S_a = \frac{P}{A} + (P\Delta_t + M_w)\frac{c}{I} \qquad (1)$$

where S_a is the allowable stress in pounds per square inch,

P, the allowable axial load in pounds applied at +29 feet,

A, the metal area of the 20-inch H-40 casing in square inches,

Δ_t, the maximum deflection with respect to the point of application of P, including the deflection due the axial load, inches,

M_w, the maximum moment induced by the wave forces in inch-pounds,

c, the radius to the outer fibers of the 20-inch H-40 casing in inches, and

I, the combined moment of inertia of the three outer strings of casing in inches to the fourth power.

The allowable stress, S_a, for the 20-inch H-40, 94-pound casing is based on a minimum joint strength of 487,000 pounds. Using a factor of safety of 1.8 and 26.9 square inches cross-sectional area, this pipe gives an allowable stress of 10,058 pounds per square inch. The maximum deflection, Δ_t, is defined by the relation

$$\frac{P\Delta_t + M_w}{M_w}\Delta_w = \Delta_t \qquad (2)$$

where Δ_w is the maximum deflection with respect to the point of application of the axial load, due to the wave loading only.

Relations (1) and (2) can be combined to give a quadratic expression

$$P^2 - P\left(AS_a + \frac{M_w}{\Delta_w}\right) + \frac{M_w A\left(S_a - \frac{M_w c}{I}\right)}{\Delta_w} = 0 \qquad (3)$$

in which P is the only unknown.

Substituting for A, S_a, c and I gives

$$P^2 - P\left[26.9\,(10{,}058) + \frac{M_w}{\Delta_w}\right] + 26.9\frac{M_w}{\Delta_w}\left(10{,}058 - \frac{M_w}{491.1}\right)0 = \quad (3a)$$

The solution of (3a) requires that calculations be carried to five significant figures to develop a fair curve.

After determination of the allowable load by the preceding method, a check was made with a straight line column formula which gives the critical buckling stress for a column.[3]

$$S_a = 40{,}000 - 125\frac{l}{r} \quad (4)$$

in which l is the unsupported length of the column in inches, and r is the radius of gyration of the column section in inches.

The allowable axial load based on the column formula is then determined from the relation

$$P = \left(\frac{S_a}{1.8} - \frac{M_w c}{I}\right)A \quad (5)$$

The allowable axial loads as computed by relations (3a) and (5) were plotted against mean Gulf depth in Figure 5. Allowable loads computed from relations (5) are higher than (3a) throughout the range of this investigation. It is recommended that the lower curve be used.

Discussion of the Solution

A new theory has been developed for the prediction of wave forces which indicates forces substantially greater than those predicted by Munk and used in the foregoing solution.[4] As the experiments from which the new equations were developed were performed with low Reynolds numbers and on only one size pile, one-half inch, the results indicate the need for additional wave force research but do not justify abandonment of Munk's equations.

The assumed strength of the casing in solution (3a) is based on API minimum joint strength. The factor of safety of 1.8 usually applied in design of casing strings in tension is considered adequate because of satisfactory experience in completed wells, and is justified in comparison with higher factors used by the building industry because the major axial load is concentric and static.

The assumption of a fixed lateral support at ten feet above mean Gulf Gulf level is justified because the change in stress at the lateral support where the stress is maximum is negligible even with a lateral movement of six inches. Calculations have shown that a platform movement of more than six inches, the estimated maximum under hurricane conditions, is required to develop a bending stress at the point of fixity below the Gulf floor greater than the stress at the platform support.

The original Grand Isle casing program on which this solution is based has been revised by substituting 30-inch for the 26-inch conductor pipe. This change increases the allowed casinghead load because the resistance to bending is proportional to the cube of the diameter while the wave force absorbed varies directly as the diameter. It also allows additional space for gravel packing.

REFERENCES

[1] Walter H. Munk, "The Solitary Wave Theory and Its Application to Surf Problems," Annals of the New York Academy of Sciences, Vol. 51, Art. 3, Pages 376-424, May, 1949.

[2] Walter H. Munk, "Wave Action on Structures," AIME Technical Paper No. 2322, March, 1948.

[3] Fred B. Seely, "Resistance of Materials," Page 200, 1935.

[4] J. R. Morison, M. P. O'Brien, J. W. Johnson, S. A. Schaaf, "The Force Exerted by Surface Waves on Piles," Report HE-116-308, University of California, Department of Engineering, Fluid Mechanics Laboratory, Berkeley, California, August 22, 1949.

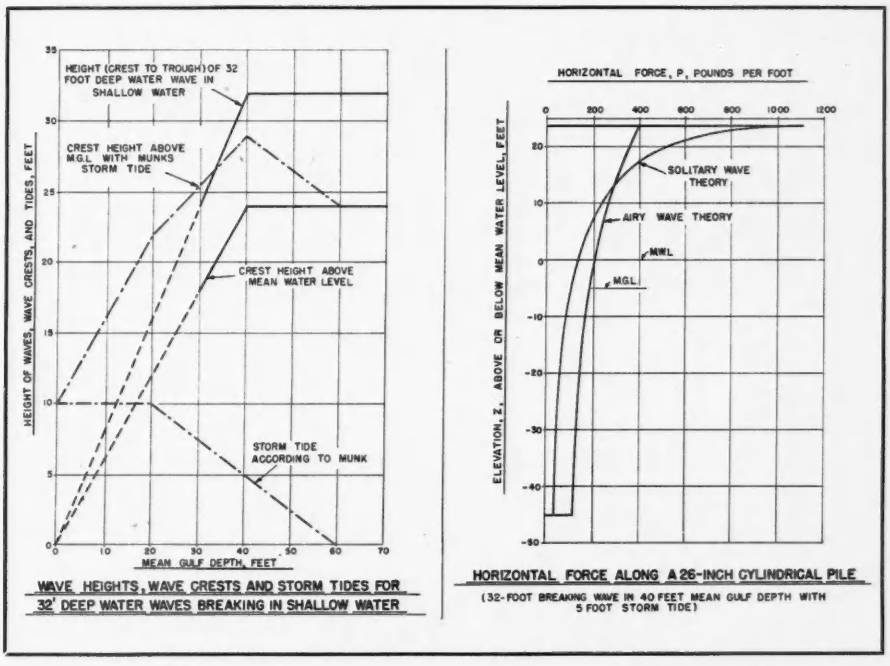

HEIGHT (CREST TO TROUGH) OF 32 FOOT DEEP WATER WAVE IN SHALLOW WATER
CREST HEIGHT ABOVE M.G.L. WITH MUNKS STORM TIDE
CREST HEIGHT ABOVE MEAN WATER LEVEL
STORM TIDE ACCORDING TO MUNK
HEIGHT OF WAVES, WAVE CRESTS, AND TIDES, FEET
MEAN GULF DEPTH, FEET
WAVE HEIGHTS, WAVE CRESTS AND STORM TIDES FOR 32' DEEP WATER WAVES BREAKING IN SHALLOW WATER
HORIZONTAL FORCE, P, POUNDS PER FOOT
SOLITARY WAVE THEORY
AIRY WAVE THEORY
MWL
MGL
ELEVATION, Z, ABOVE OR BELOW MEAN WATER LEVEL, FEET
HORIZONTAL FORCE ALONG A 26-INCH CYLINDRICAL PILE
(32-FOOT BREAKING WAVE IN 40 FEET MEAN GULF DEPTH WITH 5 FOOT STORM TIDE)

FIGURE 2

FIGURE 3

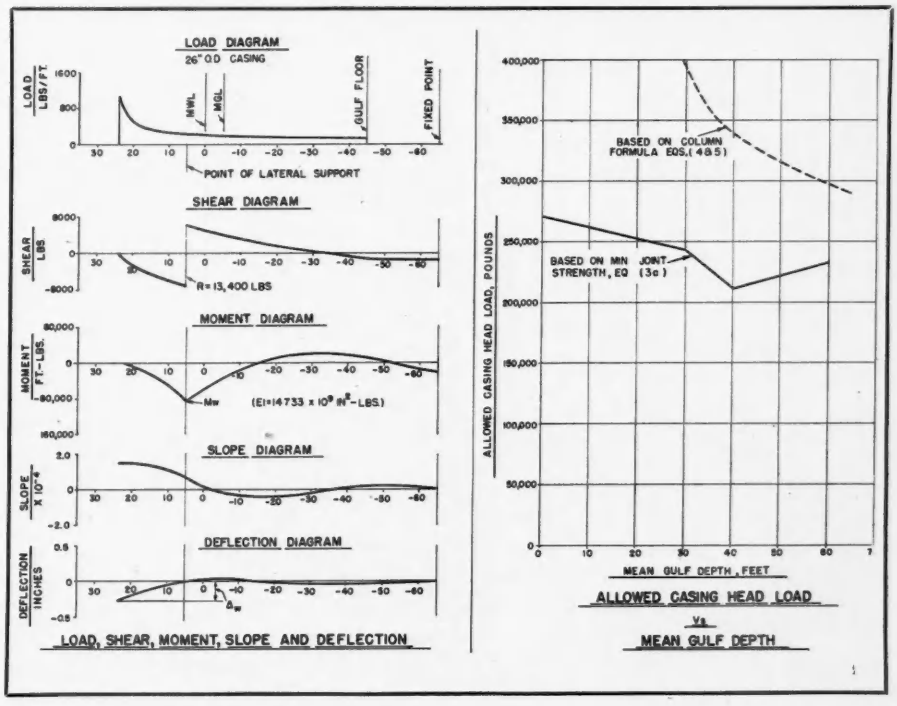


Diagram for 40-foot M.G.D., 32-foot breaking wave, five-foot storm tide, and casing column as per Figure 1.

FIGURE 4

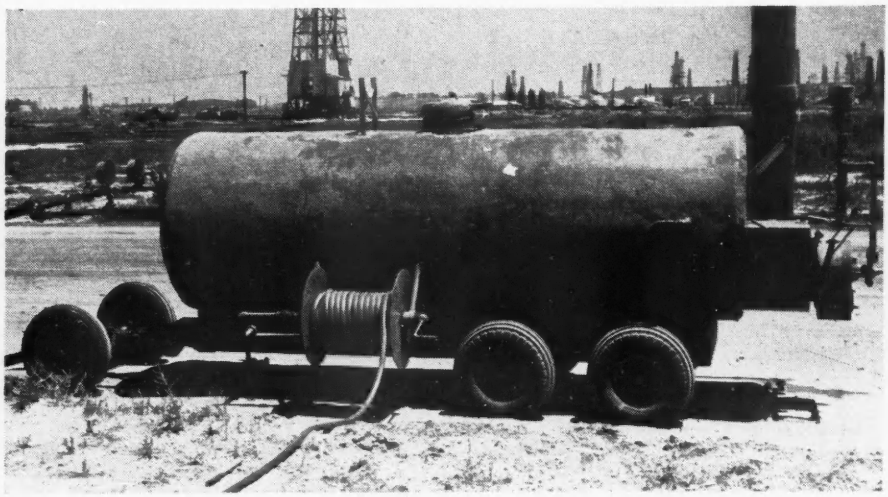
FIGURE 5

Heater

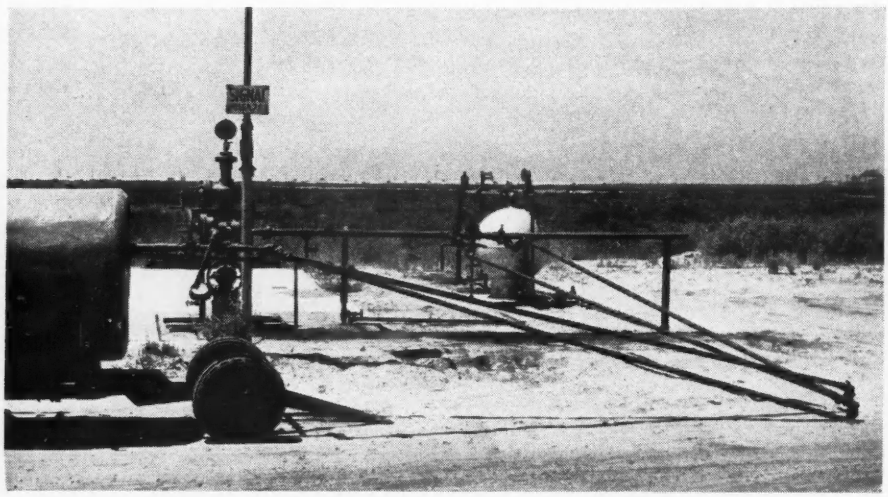
For Lead Line Paraffin Removal

WHEN wells are beaned down from a high flowing pressure to a much lower lead line pressure, wax and paraffin are removed by melting with a portable heater, self-contained with the exception of a supply of fuel. The heater is designed to operate in a horizontal position with the combustion chamber and stack at one end where thermostats control heating temperatures. The unit is mounted on a three-axle trailer made by converting a war surplus bomb truck to oil field service. It is equipped for towing behind a pickup or lease truck, and, due to being supplied with pneumatic tires, is capable of any reasonable speed.

Since most leases are piped for drilling fuel with the lines left in place for future operations, gas is available at some point near each producing well. The unit is provided with a hose with sufficient length to reach any connection near the well to supply fuel to the burners of the heating unit. The hose is stored on a hand cranked reel attached to the substructure of the heater with brackets to extend the reel away from the shell so the hose can be gathered in when moving across the lease to another well. Connections between the hose and the fuel supply lines at the heater are through packed swivel joints, similar to those employed with water hose reels.



Heater is mounted on surplus bomb truck that provides three axles and six rubber-tired wheels. Towbar is supplied so that lease truck or pickup can move it freely. Hose reel mounted on side is to carry fuel from pipe line to burners.



Flexibility of the hookup permits the heater to be placed at any reasonable distance from the lead lines, parallel or head-on.

The lead line on the individual well is prepared with fittings to attach the circulating lines of the heater. Each line follows the same pattern and has identical connections. A block valve is set into the line downstream from the well head and flow bean is placed between two connections fitted with valves and connections to attach the circulating lines. The heater contains two pipe lines, to and from the unit, equipped with lubricated swivels or flexible joints so almost any position can be obtained when making welded connections. Each separate line contains three such fittings; one at the heater units, one approximately midway between the ends and one at the point where the line is attached to the flow string. With these facilities, the heater can be spotted at almost any position within reaching distance of the pair of circulating lines and operated without additional fittings or connections.

With the heater connected to the lead line, all valves are opened and then the block valve is closed between the heater line connections. Oil passes through the heating element and the temperature is raised to a point where returning oil melts the paraffin and wax from the remainder of the line leading to stock tanks or oil and gas separators. This heater is being used on flowing wells, jack unit pumping wells, or wells which are produced with returned oil under high pressure

Corrosion Control

In Water-Flooding

By FREDERICK LATTER

Pur-O-San Company, Bradford, Penn.

THE TYPE AND CONDITION of the input water is of primary consideration in the secondary recovery of oil by water flooding. In the Bradford field most of the water used for flooding purposes is fresh water obtained from springs, streams or wells. It is treated primarily to prevent corrosion and to prevent sand-face plugging by the products of corrosion, by bacteria and other micro-organisms, or by chemical precipitants. Attention is now being given to water treatment by wetting agents and other allied chemicals in an attempt to improve the "scrubbing" action of the water in the removal of oil from the sand.

CORROSION in water-flooding is of primary importance because the cost of replacement and maintenance of pipe and equipment is of vital economic importance in stripper wells producing one-half barrel or less of oil per day. In such cases it may determine whether or not such a well is to continue in production or to be abandoned. The products of such corrosion may be deposited in the pores of the sand, causing a continual decline in input rates through the resulting lesser amounts of water being forced through the sands and lessened oil production.

This sand-face plugging caused by both the products of corrosion and micro-organisms usually takes place first in the tighter sand sections. In the Bradford field, most of the wide open or more permeable sand sections have lost much or all of their producible oil by previous production. The major portion of the oil remaining in the sand is in the tight sand sections which are most readily plugged off by such impurities in the input water.

There is no standard form of water treatment in this area. The treatment customarily used in the past consisted in the addition of inorganic chemicals to the water followed by passage through settling tanks and a filter system to remove the precipitants formed. The water so formed is usually clear and chemically stable. It may or may not contain dissolved oxygen, depending on the type of treatment used and the type of chemicals added. It is usually scale forming and the cost of such treatment will average from 1/10 to 2/10 cent per barrel.

Various laboratories have been attempting to find a simpler type of water treatment that will be no more expensive, and possibly less so, and will still be equally or more effective in corrosion and bacterial control. Use of a single organic amine type chemical has been investigated by various laboratories and reported in the literature.[1-6] These chemicals have proven extremely effective bactericides and corrosion inhibitors. Their use is simple, involving only the injection of a solution of the chemical before filtering. Their cost is in the neighborhood of .05 cent per barrel as compared with the .1 or .2 cent per barrel of the standard water treatment. In addition, they have great value as a wetting agent with the resultant possibility of increased oil production by a more effective type of water flooding.

TABLE 1
Water Analysis Before and After Treatment With Type A Corrosion Inhibitor

	Untreated	Treated
Appearance when sampled	Clear	Hazy
Appearance after standing	Hazy	Cloudy
Odor	Sulfur	Disagreeable
Taste	Sulfur	Disagreeable
Temperature, °F.	48	74
pH	7.4	7.3
Carbon Dioxide, ppm.	9	38
Dissolved Oxygen, ppm.	11.9	Not determined
Residual Chlorine, ppm.	Not determined	0
Color, ppm. Pt.	18	38
Turbidity, ppm.	3.0	12.4
Sulfates, ppm. SO_4	2.5	4.8
Manganese, ppm. Mn	0.5	0.0
Iron (Total) ppm. Fe	0.5	2.0
Alkalinity	7.4	7.9
Chlorides, ppm. Cl	151	2.0
Silica, ppm. SiO_2	9	2
Calcium, ppm. Ca	23	18
Magnesium, ppm. Mg	6	2

TABLE 2
Water Analysis Before and After Treatment With Type A Corrosion Inhibitor

	Untreated	Treated
Total Solids	320 ppm	2498 ppm
Volatile Solids	151 ppm	2344 ppm
Non-Volatile Solids	169 ppm	154 ppm
Silica	12 ppm	10 ppm
Alumina	0.7 ppm	0.5 ppm
Iron Oxide	0.2 ppm	0.2 ppm
Calcium Oxide	109.3 ppm	105.3 ppm
Magnesium Oxide	21.0 ppm	20.9 ppm
Chlorides	14.2 ppm	13.8 ppm
Sulfates	9.6 ppm	8.4 ppm
Alkalinity as Calcium Carbonate	180.4 ppm	
Dissolved Oxygen	4.9 ppm	None
Dissolved Carbon Dioxide	None	None
Manganese	None found	None found

All results are in parts per million.

TABLE 3
Water Analysis Before and After Treatment With Type A Corrosion Inhibitor

	Untreated	Treated
Total Solids	770	1072
Volatile Solids	392	652
Non-Volatile Solids	378	420
Chlorides	248	Not determined
Sulfates	71.7	77.5
Iron	1.2	0.9
Manganese	0.3	0.01
Calcium Oxide	199.9	179.8
Magnesium Oxide	None found	None found
Hardness	360	324
Alkalinity	22.0	Not determined
Dissolved Oxygen	8.2	None found
Dissolved Carbon Dioxide	None found	None found

Note: The figures indicate parts per million.

A product which has had successful application in water treating problems consists of a mixture of a quaternary ammonium salt, a condensed ethylene oxide-fatty acid wetting agent, and sodium nitrite which combines the action of the amine-type chemicals mentioned above with the action of the non-ionic wetting agent and with the ability to combine with and remove oxygen from the treated water. It is non-toxic, non-irritating to the skin and safe for human consumption in the quantities used in flood waters. To simplify the reading of charts and graphs, this mixture will be referred to on them simply as "Type A." No other mixture appears on or is concerned in charts or tables.

Upon the addition of this product to water an immediate slight increase in the turbidity of the water is noted. This turbidity is caused by the precipitation of chemical compounds and micro-organisms. These precipitants, since they form immediately, can be filtered out at the filtering plant, leaving the water clear and non-corrosive. This mixture has been reported to dissolve in lease waters without heat;[6] the condition of the water at the end of the line was pure; and pump speeds had to be increased, indicating improvement in intake rates.

In some few cases in the Bradford field, produced brines are being used for water flooding. They have the advantage of keeping the clay content of the sands in a permanently flocculated condition. The mixture referred to above has the advantage of being compatible with brines. Its effectiveness as a corrosion inhibitor in treating brines and produced waters for flooding purposes has been field-tested in Kansas, showing a substantial reduction in corrosion. These results will be published in a subsequent article.

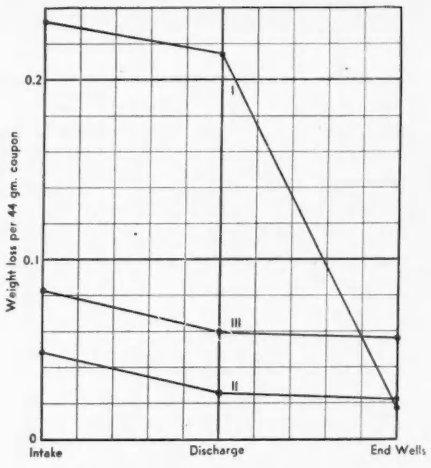
Inhibiting Corrosion

The corrosive tendency of oil field flood waters presents two problems to the operator: the cost of replacement of pipe and equipment and the loss of production as a result of the sand-face plugging by the products of such corrosion. The chief corrosive agents in flood waters are oxygen, hydrogen sulfide, carbon dioxide and possibly organic acids.[7] Of these, oxygen corrosion is the most serious factor in water flooding. The effects of such corrosion have been discussed in detailed by other authors.[5, 7, 8, 9] In general, however, it attacks the iron in the pipe forming iron oxide, causing rapid pitting of the pipe, and plugging of the sand face with iron oxide rust. The inhibitor mentioned above in concentrations as low as one part per million will react with the oxygen in flood waters and remove it. It also forms a protective coating on the inside of the pipe, thus preventing or inhibiting corrosive attacks by other agents.

The removal of dissolved oxygen from lease waters by this type of treatment is shown in Tables 1, 2, 3 and 4. These are samples of lease waters from different leases owned by different companies and distributed throughout the Bradford field.

The results of field corrosion tests using coupons are shown in Table 5 and Figures 1 and 2. The coupons were placed in the source or intake water, in the discharge line carrying the water from the filter, and at the end wells on the lease. Table 5 gives the weight loss per 44 gram coupon at each of these points using treated water. On the first lease no tests were made before the treatment started. After two tests were made, each of six weeks duration, using different quantities of inhibitor, an additional six-week test was made using raw water. The amount of corrosion increased at each point during the raw water test. It was not as marked as might be expected by the original decrease due most probably to the film forming inhibiting characteristics of the amine-type chemical used. The film formed by this inhibitor should continue to protect the pipe for some time after its addition is discontinued, although the amount of protection will gradually decrease with time.

Figure 2 shows a similar coupon test on the second lease reported in Table 5. Here the decrease in corrosion between the intake water and the discharge point was more marked. The intake water on this lease was more corrosive than that on the previous lease. In both of these tests the second six-week testing period showed less corrosion than the first. In the second lease the same concentration of inhibitor was used for both testing periods, indicating that the increased effectiveness of the inhibitor was due to the protection afforded by the film formed on the pipe by continued addition of inhibitor.



TIME OF TREATMENT — TYPE A INHIBITOR USED
I. 7/2/48-8/11/48 — Ave. 5 qt./wk.
II. 8/11/48-9/28/48 — Ave. 2 2/3 gal./wk.
III. 10/8/48-11/19/48 — Raw Water

FIGURE 1. Corrosive coupon tests on Type A treater water (Lease 1).

Bactericidal Action

The growth of micro-organisms and/or algae in input water may cause serious plugging of the sand pores. These are ordinarily removed from input water by chlorination either with chlorine or with sodium hypochlorite injected at the filter plant. However, there are certain strains of bacteria which are not affected by chlorination. They may continue to grow and to multiply and

TABLE 4

Water Analysis Before and After Treatment With Type A Corrosion Inhibitor

	Untreated	Treated
Total Solids	290.0	434.0
Volatile Solids	128.0	262.0
Non-Volatile Solids	162.0	172.0
Sulfur Trioxide	26.0	26.0
Chlorides	44.0	18.0
Iron	0.2	0.1
Manganese	None found	None found
Calcium Oxide	99.7	94.4
Manganese Oxide	6.1	6.1
Hardness	186	172
Alkalinity	72	110 (Methyl Orange)
Oxygen	8.2	None found
Carbon Dioxide	None found	None found

All results in parts per million.
Alkalinity and hardness in terms of Calcium Carbonate.

TABLE 5

Water Analysis Before and After Treatment With Type A Corrosion Inhibitor

		INTAKE WATER		DISCHARGE WATER		END WELLS	
Test Period	Treatment	Weight Coupon	Weight Loss	Weight Coupon	Weight Loss	Weight Coupon	Weight Loss
Lease 1:							
7/ 2/48— 8/11/48	2 qt./wk.—2 wks.	44.0016 gm.	0.2245 gm.	44.1237	0.2139	44.2050	0.0169
	3 qt./wk.—1 wk.	.....	.....	.....	.....	.....	.....
	8 qt./wk.—3 wks.	.....	0.0484	.....	.....	.....	.....
8/11/48— 9/28/48	2 gal./wk.—4 wks.	43.4075	.....	43.2899	0.0271	43.5832	0.0227
	4 gal./wk.—2 wks.	.....	.....	.....	.....	.....	.....
10/ 8/48—11/19/48	Raw Water	43.5569	0.0819	43.3640	0.0588	43.5402	0.0507
Lease 2:							
8/13/48—11/24/28	½ gal./day (10 PPM)	43.4870	0.9189	43.5624	0.1970	43.6289	0.0607
11/24/48— 1/ 5/49	10 PPM	43.4665	0.9755	43.4399	0.0928	43.4091	0.0305

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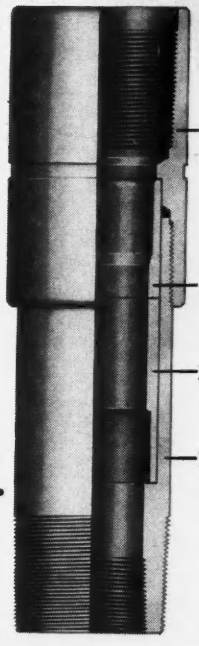

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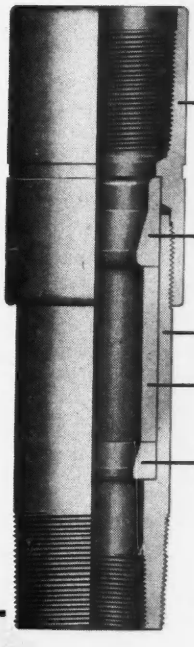

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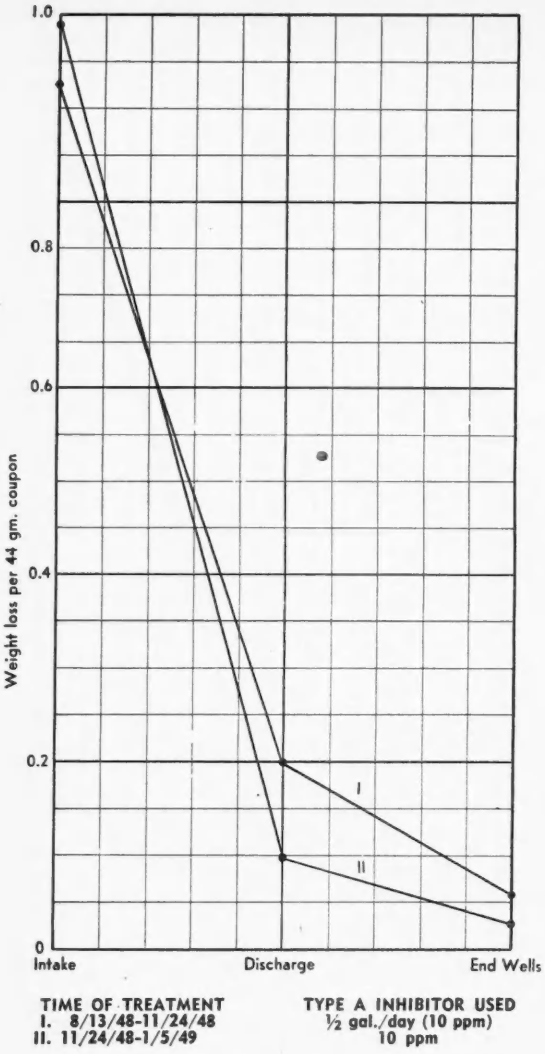

FIGURE 2. Corrosion coupon tests on Type A treated water (Lease 2).

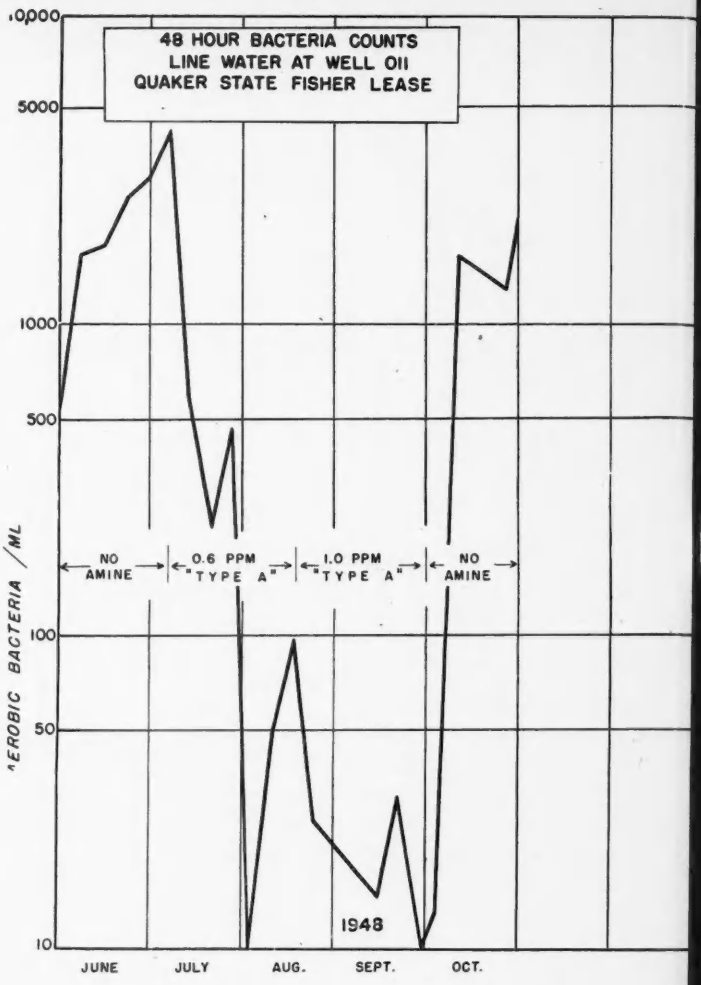

FIGURE 3. "Type A" treatment experiment.

their deposition on the sand face may cause plugging with the corresponding decline in the water injection rate. The use of this product as both a corrosion inhibitor and bactericide results in an almost complete removal of all of these organisms. Table 6 shows the results of laboratory bacterial tests on lease waters in the Bradford field. The powerful bactericidal action of .6 to 1 ppm. of this mixture on a particularly polluted lease water was reported by Breston[5] and is reprinted here as Figure 3. This was an actual field test of water at a line well during treatment of lease water for a period of over two months.

Similar field tests by other engineers[5,6] show it to be effective in controlling both microbiological growths and corrosion as evidenced in the surface distribution lines and in the backflow from the input wells.

Conclusions

1. A mixture of a quaternary ammonium salt, a condensed ethylene oxide-fatty acid wetting agent and sodium nitrite has proven highly effective in combating corrosion in water flooding operations, in controlling micro-biological growths, and gives indications of increasing intake rates.

2. This mixture removes oxygen from input waters thus preventing oxygen corrosion.

3. It forms a protective film on metal surfaces, thus inhibiting other types of flood water corrosion.

4. It is effective as a bactericide, preventing the growth of bacteria algae and other micro-organisms.

5. It is compatible with brines and is being tested as a corrosion inhibitor for brines and produced waters used for flooding purposes.

TABLE 6

Bactericidal Action of Type A Corrosion Inhibitor Treated Water

BACTERIAL COUNT	24 Hours Incubation	48 Hours Incubation
Lease 1:		
Before Treatment.....	34	54
After Treatment.....	0	0
Lease 2:		
Before Treatment.....	6100	7300
After Treatment.....	0	0

REFERENCES

[1] Latter, Frederick. "Modern Non-Corrosi Bactericidal Treatment of Input Water." Pr ducers Monthly, v. 13, No. 6, p. 47, April, 194

[2] Breston, J. N. "Amine Type Wetting Agen as Acid Corrosion Inhibitors." Producers Month v. 10, No. 7, p. 19, May, 1946.

[3] Breston, J. N. "New Chemical Treatment Flood Waters for Bacteria and Corrosion Control Oil & Gas J. v. 48, No. 16, p. 96, August 25, 194

[4] Breston, J. N. and Barton, J. K. "Field Te of Corrosion Inhibitor for Low pH Flood Water Oil & Gas J. v. 46, No. 31, p. 91, December 1947.

[5] Breston, J. N. "Conditioning Water for Se ondary Recovery of Oil in the Appalachi Fields," Producers Monthly, v. 14, No. 7, p. 1 May, 1950.

[6] Heck, E. T., Barton, J. K., and Howe W. E. "Further Field Test Results on Use Corrosion Inhibitors and Bactericides for Secon ary Flood Waters." Producers Monthly, v. 13, N 7, p. 27, May, 1949.

[7] Prange, F. A. "Corrosion in Water-Flo Operations." World Oil v. 130, No. 5, p. 1 April, 1950.

[8] Pfister, R. J. "Corrosiveness of Oil Field Flo Water." Producers Monthly, v. 9, No. 2, p. Dec. 1944.

[9] Pfister, R. J. "Dissolved Oxygen in Oil Fi Flood Waters." Producers Monthly, v. 9, No. p. 24, June, 1945.

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Oil Displacement CALCULATIONS

By J. W. LaRUE and D. A. WILSON

MANY factors, such as relative permeability relationships, viscosity ratios, and capillary pressures affect oil displacement. In 1942 Buckley and Leverett[1] suggested a method for predicting fluid displacement history in a linear system by use of the relative permeability concept. They also showed how viscosity ratios affected residual oil saturations during flooding for a particular relative permeability curve.

It is the purpose of this paper to show how the Buckley and Leverett calculation is affected by using various relative permeability curves. No previous work making this comparison has been published.

Displacement histories were calculated for four different relative permeability curves. These relative permeability data were originally presented by Harrington[2] for cores obtained from the Nelly Bly sand, Basal Bromide sand, Wasson limestone, and McClosky limestone formations. Basic core data from this source are included in Table 1 and the various relative permeability curves are presented in Figures 1, 4, 7, and 10.

No attempt is made here to verify the validity of this method of calculating displacement. This could be accomplished only by comparing the calculated results with actual performance data. In order to obtain more reasonable variations between relative permeability curves, actual rather than assumed curves were used.

THE AUTHORS present calculations for oil displacement by water for sand and lime cores having a different relative permeability relationship and compare the data to show how such relationships affected this type of calculation. Especially prepared for WORLD OIL, this article is based on a discussion of a graduate problem presented before a joint meeting of the Mid-Continent and Oklahoma Sections, AIME, at Tulsa University, Tulsa.

To eliminate as many variables as possible, a linear system 1000 feet long and one square foot in cross-sectional area was assumed for all calculations. A constant injection rate of 10 cubic feet per hour and a viscosity ratio (K_w/K_o) of 5 to 1 were chosen.

The cores were assumed to contain a connate water saturation equal to the value indicated for zero water flow on the relative permeability curves. The remainder of the pore space was assumed to be originally saturated with gas free oil.

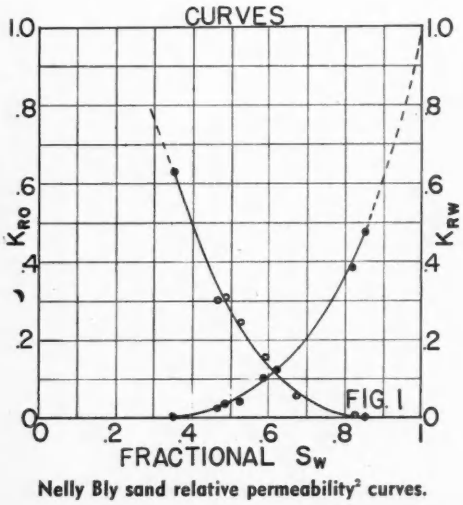
Procedure Used

Using the above mentioned conditions the displacement history for each core was calculated as shown by Buckley and Leverett. The fraction of water flowing at any particular saturation was calculated according to

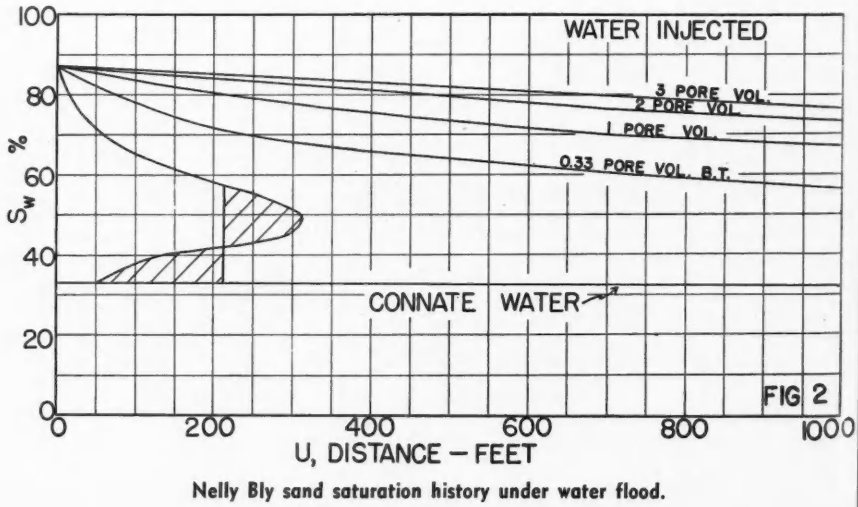
$$F_w = \frac{1}{1 + \frac{K_o \mu_w}{K_w \mu_o}}$$

F_w = Fraction water flowing
K_o = Effective permeability to oil
K_w = Effective permeability to water
μ_o = Oil viscosity (centipoise)
μ_w = Water viscosity (centipoise)

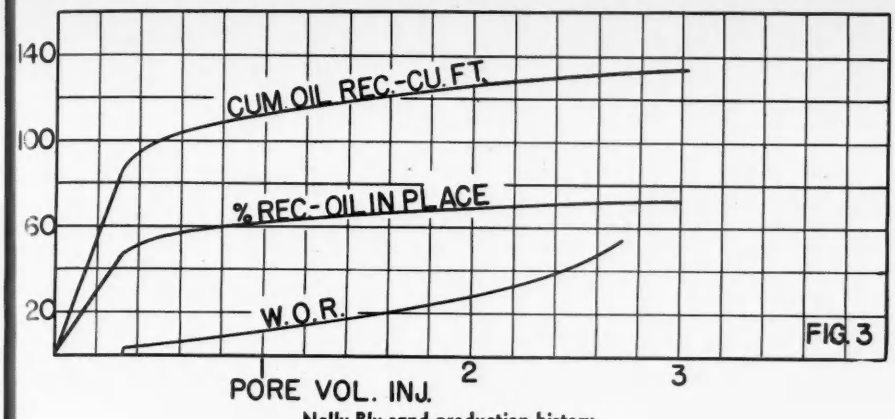
A curve of F_w versus S_w was plotted by using a particular relative permea-



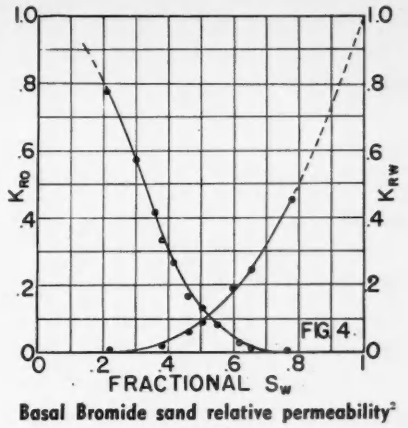
Nelly Bly sand relative permeability[2] curves.



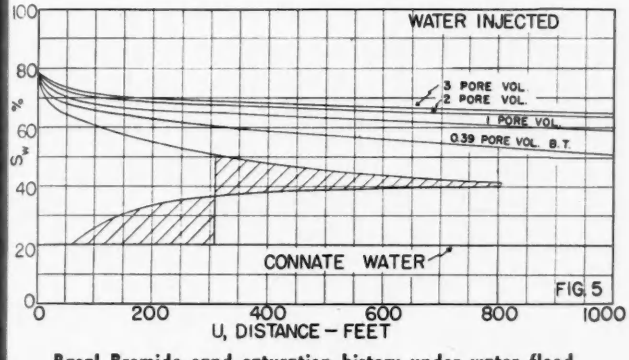
Nelly Bly sand saturation history under water flood.



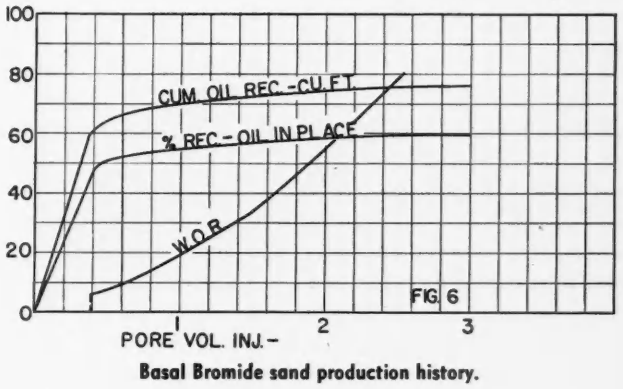
Nelly Bly sand production history.



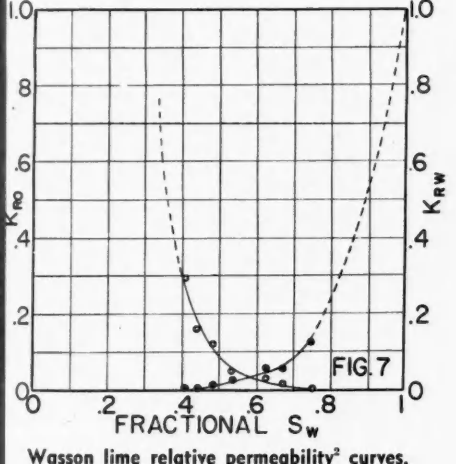
Basal Bromide sand relative permeability[2] curves.



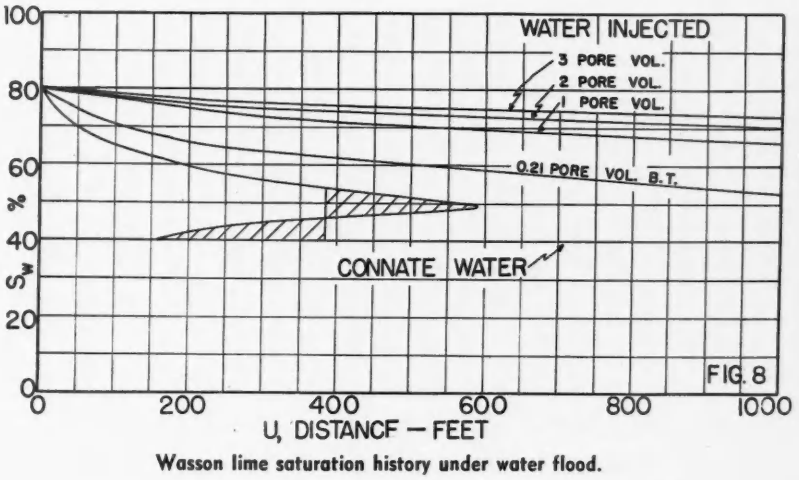
Basal Bromide sand saturation history under water flood.



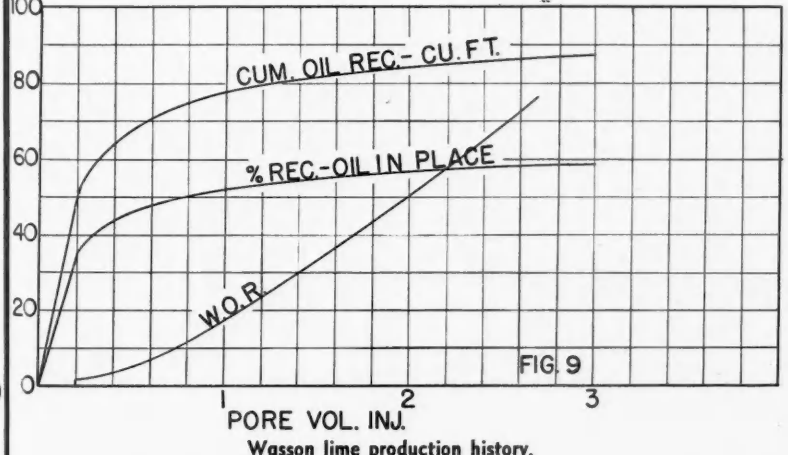
Basal Bromide sand production history.



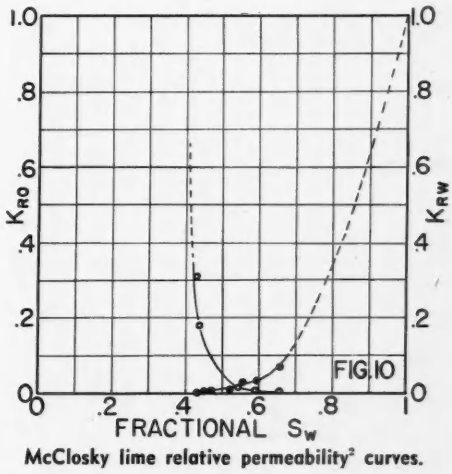
Wasson lime relative permeability[2] curves.



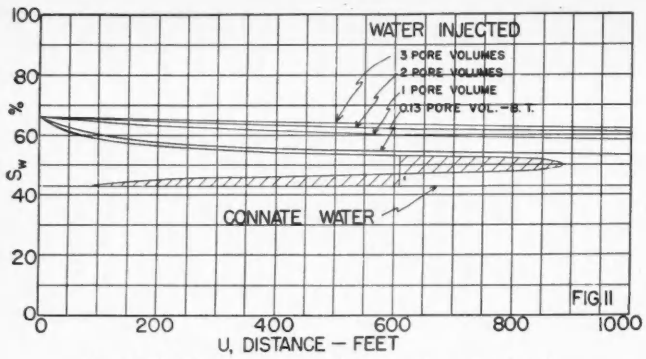
Wasson lime saturation history under water flood.



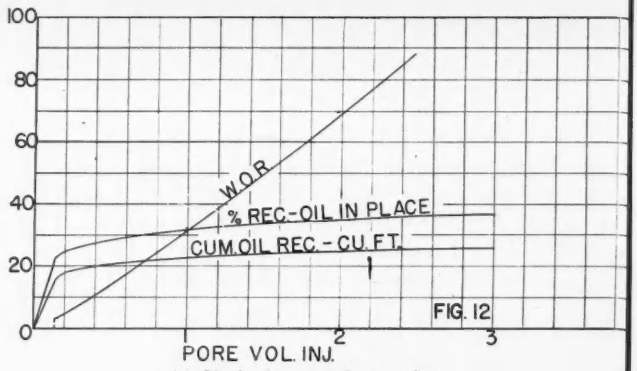
Wasson lime production history.



McClosky lime relative permeability[2] curves.



McClosky lime saturation history under water flood.



McClosky lime production history.

bility curve. The slope at various water saturations was taken graphically and plotted as $\frac{dF_w}{dS_w}$ versus water saturation. To compute the saturation distribution for any amount of water injected prior to breakthrough, the location of a plane of fixed saturation along the core was calculated by the equation:

$$U = \frac{Q_t \, dF_w}{\Phi A \, dS_w}$$

where

U = Distance from input end of core to location of plane of fixed saturation

Q_t = Volume of water injected

Φ = Porosity of core

A = Cross-sectional area of core

$\frac{dF_w}{dS_w}$ = Graphical derivative of F_w vs. S_w curve taken at various saturations

Curves were then prepared for each core by plotting the water saturations as a function of the distances U for a given value of Q_t. These relationships are shown in Figures 2, 5, 8, and 11.

It can be seen that a part of the first curve on each of these figures is triple valued. Since a situation of this type is physically impossible, part of the curve was assumed to be imaginary and the hatched areas as shown were balanced so that the area between the connate water line and under the curve was equal to Q_t/A. This method, which is equivalent to that of Buckley and Leverett, assumes a definite flood front as shown by the resulting vertical line dividing the balanced areas. Although this interpretation may not be entirely correct, the saturation to water increases at such a rapid rate at this point that very little variation between this vertical line and a true curve could be expected.

The average water saturation to the flood front for all volumes injected will be the same. With this value of the water saturation it was possible to calculate the volume of water that would have to be injected to create breakthrough. With this particular volume, (Q_t) the saturation distribution curve at breakthrough was calculated.

To show the displacement histo after breakthrough, calculations we made for additional volumes of wat to be injected. The balancing of the additional curves obviously was n necessary since the triple valued po tions fell beyond the physical limits the linear system.

The volume of oil produced pri to breakthrough was considered to b equal to the volume of water injecte because of the physical conditions im posed. The oil recovered after breal through was calculated by planimete ing the areas between the curves f the various volumes injected.

The water production was calcu lated as the differences between th volume of water injected and th volume of oil produced during a sp cific increment of time. This diffe ence divided by the oil produced du ing the same time increment wa taken as the average water-oil rat and plotted as such. These produ tion history curves are presented i Figures 3, 6, 9, and 12, and Table gives actual values obtained durin the calculations.

TABLE 1

Basic Core Data

CORE	Porosity Percent	Brine Permeability Mds.	Residual Oil Saturation* Percent	Connate Water Saturation Percent
McClosky Limestone	12.35	785	34.00	43.00
Wasson Limestone	24.80	431	20.00	40.00
Basal Bromide Sand	15.95	460	22.00	20.00
Nelly Bly Sand	27.25	1080	13.00	33.00

* These values were obtained by extrapolating the points of the saturation distribution curves as a function of U to U=O.

TABLE 2

Calculated Data

CORE	Total Oil In Place Cu. Ft.	Movable Oil In Place Cu. Ft.	RECOVERY AT BREAKTHROUGH		RECOVERY AFTER BREAKTHROUGH FOR 3 P. V. INJ.	
			Percent of Oil in Place	Percent of Movable Oil	Percent of Total Oil	Percent of Movable Oil
McClosky Limestone	70	28.4	23.0	57.0	8.0	30.0
Wasson Limestone	149	99.0	35.0	53.0	22.0	33.0
Basal Bromide Sand	127	92.5	49.0	67.0	11.0	15.0
Nelly Bly Sand	182	147.0	49.0	61.0	23.0	29.0

Description of Curves

Figures 1 through 12 present th relative permeabilities, saturation hi tories under water flood, and produ tion history curves by individual core

For purposes of comparison the fo lowing curves were prepared:

Figure 13, water-oil ratio vers percent residual oil saturation.

Figure 14, K_w/K_o versus percent saturation.

Figure 15, water-oil ratio versus th percent recovered of recoverable o

Figure 16, water-oil ratio vers pore volumes injected.

Figure 17, Log K_w/K_o versus pe cent water saturation.

Discussion of Results

The close similarity between the pe meability ratio (W_w/K_o) and wate oil ratio curves as a function of resi ual oil saturation (Figures 14 and 1 respectively) indicates that the saturation at breakthrough might

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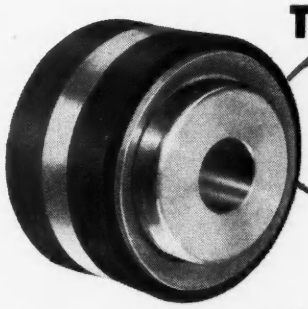

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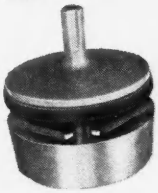

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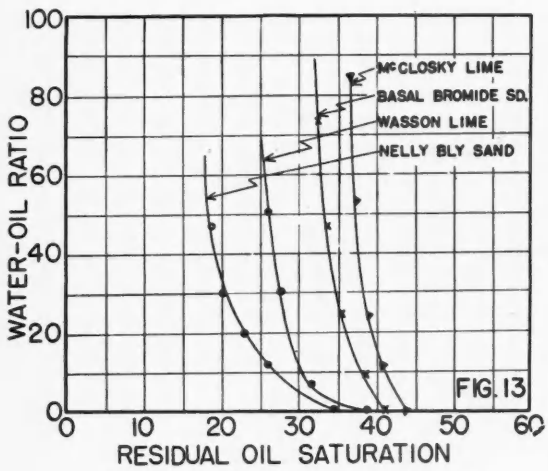
estimated from the K_w/K_o curves. This could not possibly be a definite figure, but the relative positions of the curves for various cores seem to indicate which one would have the lowest oil saturation at breakthrough.

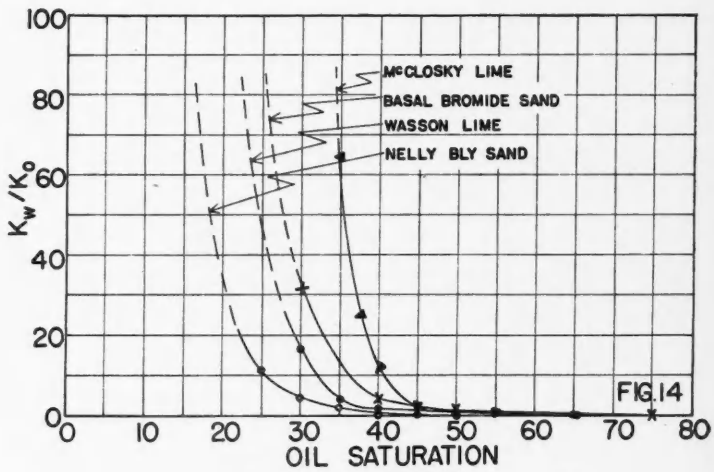
If an estimate of the oil saturation at breakthrough was desired, it could be obtained by noting approximately the point at which the K_w/K_o versus saturation curve breaks upward. For example, the Nelly Bly sand shows breakthrough occurring at an oil saturation of approximately 35 percent (Figure 13) and the K_w/K_o curve (Figure 14) breaks upward between 35 and 40 percent oil saturation.

Another comparison of interest is that which is given by the group of curves (Figure 15) which show the percent recovered of recoverable oil as a function of water-oil ratio for each core. This relationship indicates that there is very little difference between the cores as to the amount of movable oil that will be recovered at breakthrough. The total movable oil is indicated by the relative permeability curves, between the points of zero oil flow and zero water flow. Figure 15 also indicates that in any core only approximately 85 percent of the movable oil can be recovered before the water-oil ratio becomes excessive. On this basis it would seem logical to allow for such a condition when using relative permeability data to predict recoverable reserves.

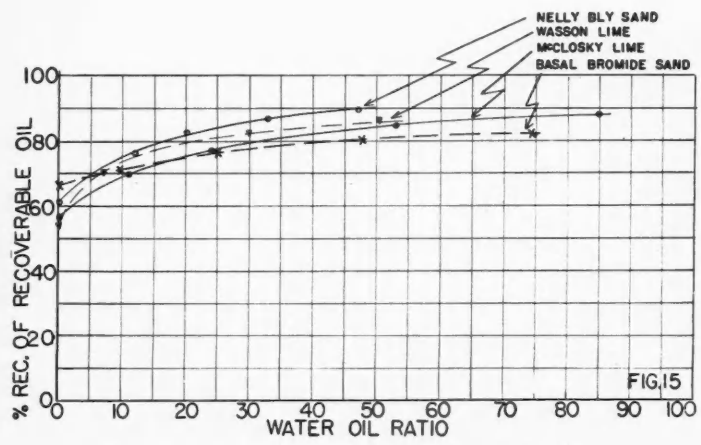
With regard to movable oil, the residual oil saturations as taken from the relative permeability curves may



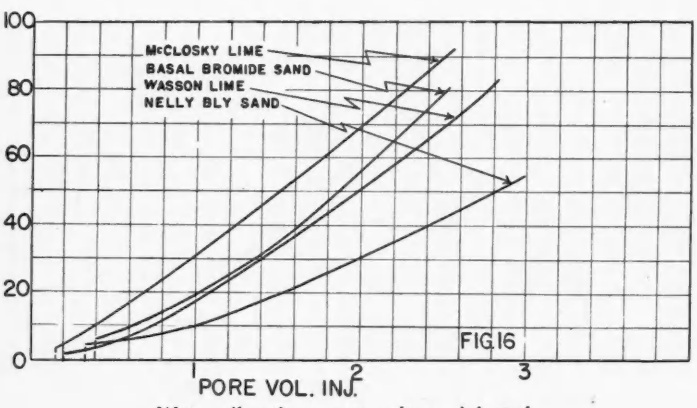
Residual oil saturation vs water-oil ratio.



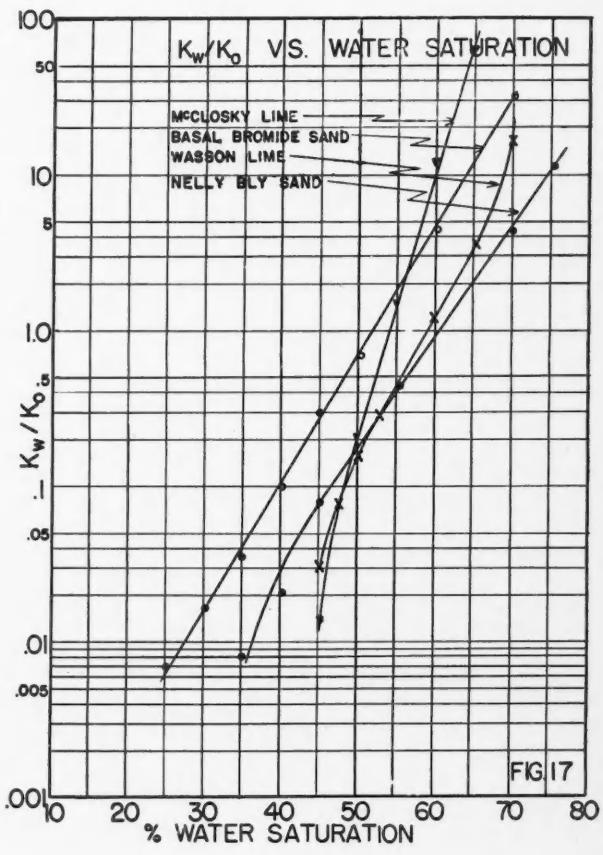
Oil saturation vs Kw/Ko.



Percent recovery of recoverable oil vs water-oil ratio.



Water-oil ratio vs pore volumes injected.



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be slightly high due to the method of obtaining these curves. The trend of the calculated points for the water saturation distribution curves during a flood indicated slightly different residual oil saturations than those indicated by the relative permeability curves. Since these differences were small, the values indicated by the saturation distribution curves (Figures 2, 5, 8, 11) were used in the displacement calculations. For example, the residual oil saturation as shown by the relative permeability curve for the Wasson Lime (Figure 7) was 24 percent, while the displacement curve (Figure 8) indicated the residual oil saturation to be 20 percent.

Figure 16 shows a comparison of the water-oil ratio curves as a function of pore volumes injected. The main significance of these curves is the fact that their slopes compare relatively with the slopes of the curves showing Log K_w/K_o versus water saturation (Figure 17). As might have been expected, this indicates that, if the slope of the curve Log K_w/K_o versus water saturation is greater for one core than another, its water-oil ratio will increase more rapidly during a flooding operation.

Conclusions

Since recoverable oil is of prime importance, it is of interest that this type of displacement calculation indicates that the relative permeability relationship for a core has little effect upon the efficiency of a water flood. They further indicate that not all of the movable oil, as obtained from the spread of a relative permeability curve can be recovered within economic water-oil ratios. These results indicate that only approximately 85 percent of the movable oil would be recovered before the water-oil ratio reaches 50 to 1, therefore it is believed that a correction factor should be applied when estimating recoverable oil from relative permeability curves.

A logical continuation of this work would be to study the effect of viscosity ratios upon the displacement histories of various systems.

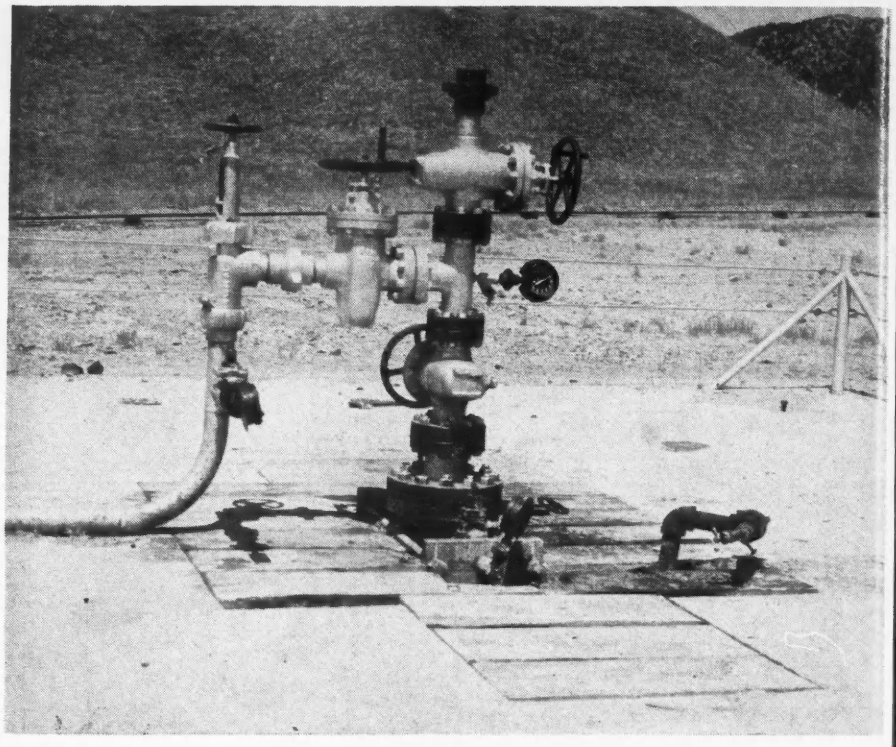
ACKNOWLEDGEMENT

The writers gratefully acknowledge the suggestions and supervision freely given by the staff of the Petroleum Engineering Department of the University of Oklahoma throughout the progression of this investigation.

REFERENCES

[1] S. E. Buckley and M. C. Leverett: Mechanism of Fluid Displacement in Sands. Trans. AIME (1942 and 1943) Vol. 146 and 151.

[2] J. D. Harrington: A Correlation of the Measurements of Capillary Pressure and Relative Permeability on Small Core Samples. Master of Petroleum Engineering Thesis; University of Oklahoma.



Changing Positive Chokes on High-Pressure Wells

By HARRY S. BAIRD
Safety Engineer, Sun Oil Company, Dallas

CHANGING positive chokes on high pressure wells can be a hazardous undertaking unless adequate safety measures are observed. Instances have been reported where field men engaged in this operation have been seriously or fatally injured due to carelessness or failure to follow a definite procedure dictated by prescribed safety rules.

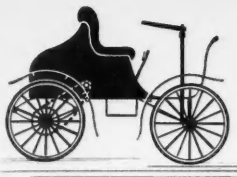
It is generally assumed when a well is producing from a high-pressure formation that this is taken into consideration and the christmas tree is first installed with high-pressure fittings, thus having a good safety factor in its hookup. But in some cases even though the tree is made up of high-pressure connections the fitting then added by the operator leading to the flow lines, etc., may be of a low-pressure design. Therefore, the correct procedure is that a tree and all accessory fittings have the adequate safety factor to hold the pressure it is likely to encounter.

There is a difference of opinion as to where the choke should be placed on the tree. This is a matter of choice to the operator. But as for the safety of the operating personnel and equipment, and to overcome a possible fire hazard, the choke should be located between the wing valve and a valve on the opposite side of the choke. A bleeder plug should be placed in this area and should be in most cases a part of the choke assembly.

After the christmas tree and its connections have been installed with the proper fittings, in changing these chokes the field man should observe the following steps, designed to minimize potential injury to himself or property:

1. Never stand in front of choke while working.
2. Close wing valve on tree.
3. Loosen bleeder plug on choke assembly (if pressure does not release or iced condition is present, allow to set until ice melts).
4. Break the union, change choke.
5. If no indication of ice, and pressure does not release, close wing valve on tree.
6. Close master valve.
7. Romove pressure gauge.
8. Bleed off pressure through the ¼-inch valve.
9. Open wing valve slowly releasing pressure.
10. If no back pressure on flow line open flow line valve back of choke.

The above precautions taken by the field man in changing positive chokes on high pressure wells will eliminate this type of costly and serious injury.



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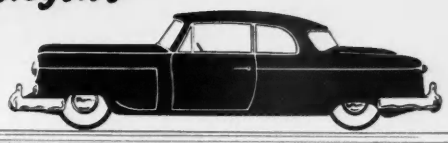

NO, of course you wouldn't.

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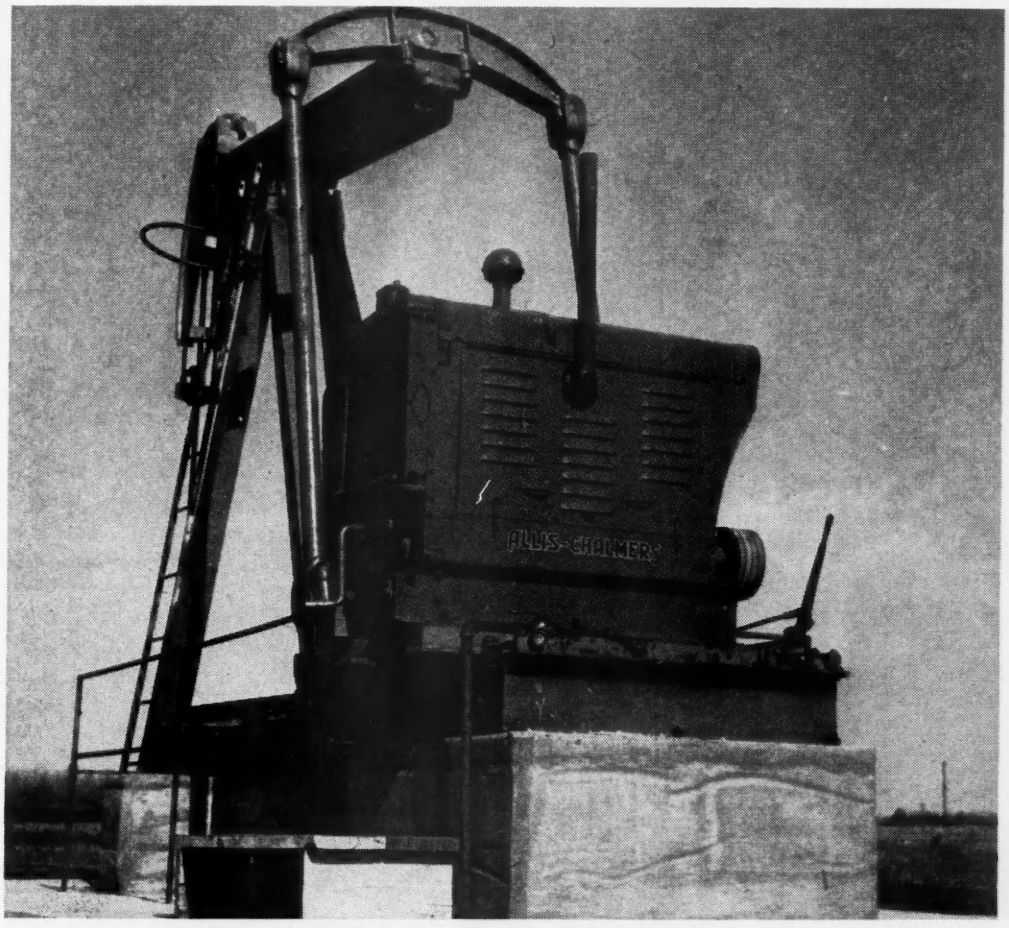

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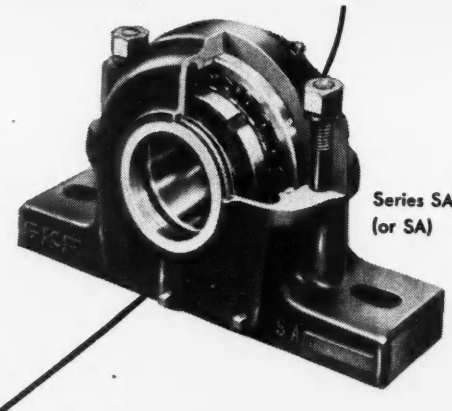
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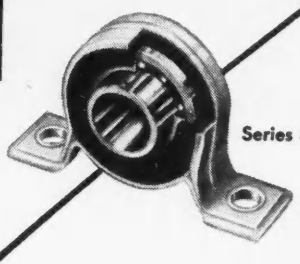
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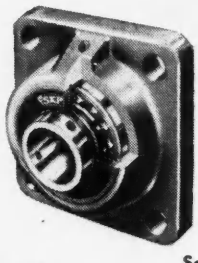
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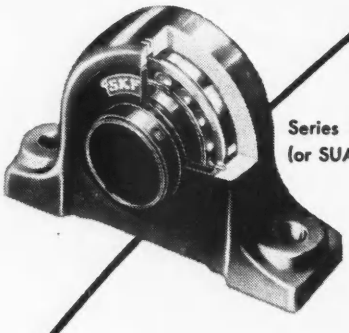
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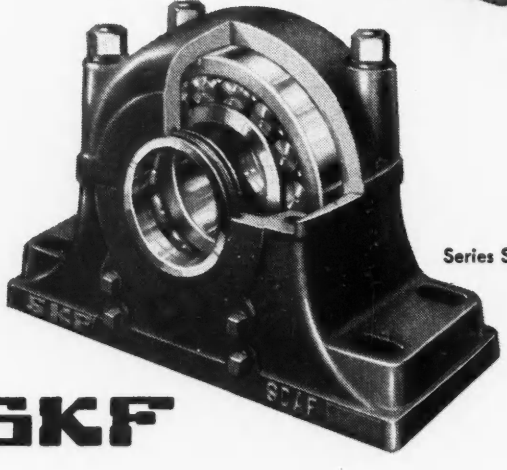
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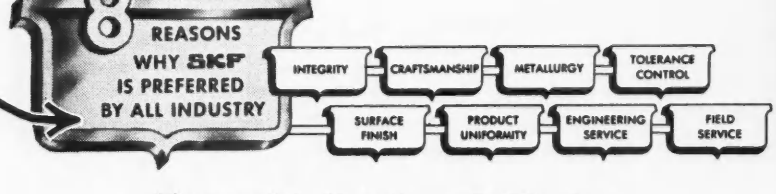

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THERMAL STRESSES

Around an Uncased Hole

Part 2

(CONCLUSION)

By K. D. SAUNDERS
Department of Engineering Mechanics, Purdue University

and

A. D. TOPPING
Department of Theoretical and Applied Mechanics, University of Illinois

IT WILL be assumed that the rock around the hole is elastic and isotropic, that the conditions of compatibility and equilibrium are satisfied, and that the state of stress is axially symmetrical. The solution of this general problem is known for the case of thermal stresses in a cylinder with a concentric hole. Timoshenko[12] gives the following for the case where $\sigma_r = 0$ at the inner and outer surfaces of the hollow cylinder:

$$\sigma_r = \frac{\mu E}{(1-\nu)r^2}\left[\frac{r^2-a^2}{b^2-a^2}\int_a^b Trdr - \int_a^r Trdr\right]$$

$$\sigma_\theta = \frac{\mu E}{(1-\nu)r^2}\left[\frac{r^2+a^2}{b^2-a^2}\int_a^b Trdr + \int_a^r Trdr - Tr^2\right]$$

$$\sigma_z = E\varepsilon_z - \frac{\mu ET}{1-\nu} + \frac{2\nu\mu E}{(1-\nu)(b^2-a^2)}\int_a^b Trdr$$

Equations (48)

For the case of a bore hole, b may be considered to approach infinity and the constant axial strain, ε_z, may be taken as zero (for if it is zero anywhere, and it apparently is at large distances from the hole, it is zero everywhere); so equations (48) become

$$\sigma_r = \frac{\mu E}{(1-\nu)r^2}\int_a^r Trdr$$

$$\sigma_\theta = \frac{\mu E}{(1-\nu)r^2}\left[\int_a^r Trdr - Tr^2\right]$$

$$\sigma_z = \frac{\mu ET}{1-\nu}$$

Equations (49)

In equations (48) and (49), T is the temperature change, $W(r,t) - W(z)$. Using equations (47) for W (r,t), the stresses become

$$\sigma_r = \frac{\mu E}{1-\nu}\left\{ma^{1/2}\left(\frac{t}{\pi\alpha}\right)^{1/2}\left(\frac{2}{5}\right)\left(\frac{r^{1/2}-a^{5/2}}{r^2}\right) - \frac{2}{3}\left(\frac{1}{r^{1/2}} - \frac{a^{3/2}}{r^3}\right)\left[\Big(W(a)-W(z)\Big)a^{1/2} + ma^{1/2}t + ma^{3/2}\left(\frac{t}{\pi\alpha}\right)^{1/2}\right]\right\}$$

$$\sigma_\theta = -\sigma_r - \frac{\mu E}{1-\nu}\left\{\Big(W(a)-W(z)\Big)\left(\frac{a}{r}\right)^{1/2} + m\left(\frac{a}{r}\right)^{1/2}\left[t - r\left(\frac{t}{\pi\alpha}\right)^{1/2} + a\left(\frac{t}{\pi\alpha}\right)^{1/2}\right]\right\}$$

$$\sigma_z = \sigma_r + \sigma_\theta$$

Equations (50)

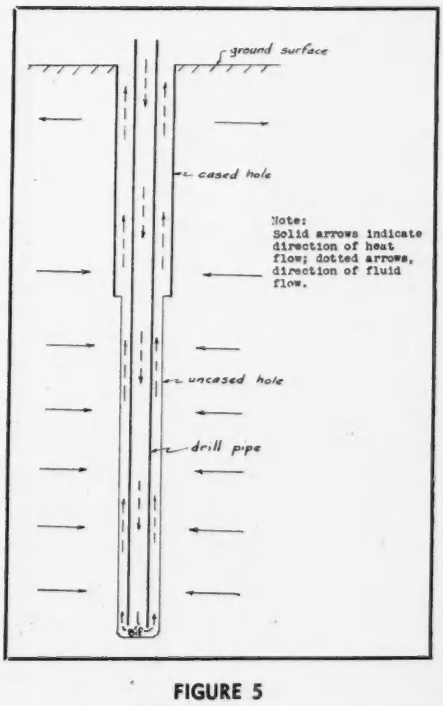
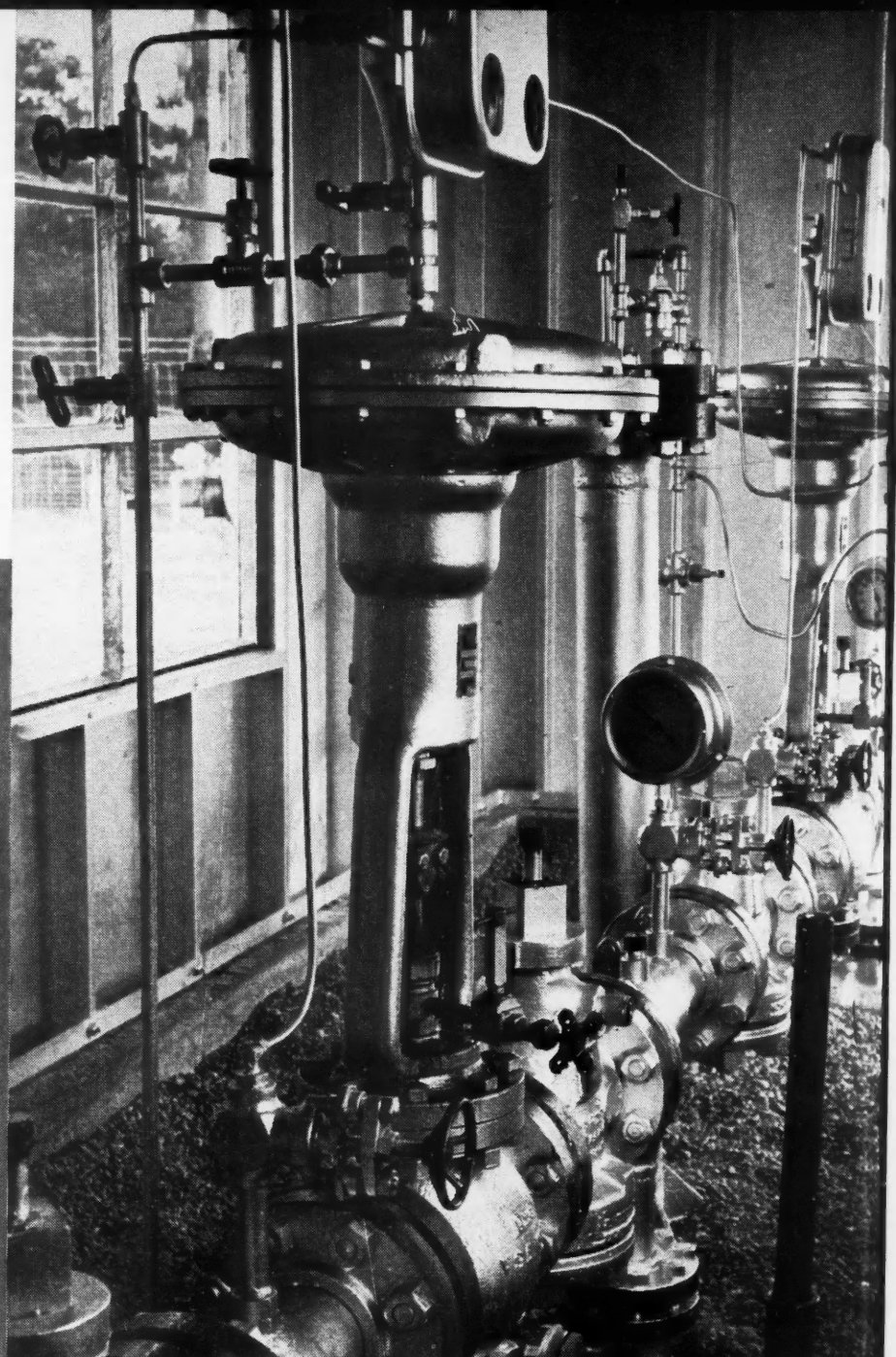
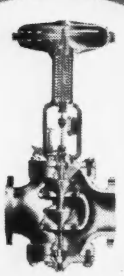


FIGURE 5





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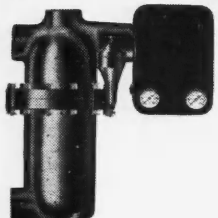

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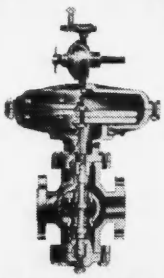

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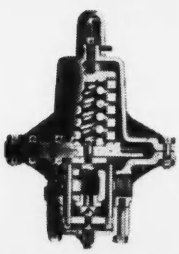

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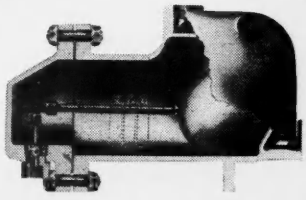

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Equations (50) are tabulated in Table 2 for the following conditions, which will be called conditions "A":

$a = 0.25$ feet
$W(a) - W(z) = -200°$ F.
$m = 0.0833°$ F. per hour
$\alpha = 0.032$ ft.²/hr.
$\mu = 4.5 \times 10^{-6}$
$E = 8.46 \times 10^{6}$ psi
$\nu = 0.25$

These conditions, except for a change in the values of t used, correspond to those that were used for Table 1 and Figure 4, and apply to a limestone formation at $z = 10{,}000$ feet. Note that the stresses in Table 2 are all tensile.

In Figure 6, $W(0.5, t)$ and the corresponding values of σ_r, σ_θ and σ_z are plotted as a typical case to show that the variation of temperature and thermal stress with time is nearly linear if $t > 24$ hours and if $W(a, t)$ is linear—that is, if m is constant. This being the case, it seems unnecessary to plot more than the values for one value of t in Figure 7, which shows the variation of the thermal stresses with the distance from the center of the hole.

The significance of thermal stresses cannot be seen until they have been superposed on the stresses resulting from the weight of the overburden and from the fluid pressure in the well. These latter are[2]:

$$\sigma_r = \frac{\nu\rho z}{1-\nu}\left(\frac{a^2}{r^2} - 1\right) - p_i\frac{a^2}{r^2}$$

$$\sigma_\theta = \frac{\nu\rho z}{1-\nu}\left(\frac{a^2}{r^2} + 1\right) + p_i\frac{a^2}{r^2}$$

$$\sigma_z = -\rho z$$

Equations (51)

for the case of axial symmetry. In Table 3, stresses from (51) are given for conditions "A" with the additional specifications that the fluid pressure p_i, equal 0.8z or 8000 psi, and that $\rho = 1$ pound per foot of depth per square inch of area (the latter does not correspond exactly to the value of ρ used in getting α, but it need not).

Table 4 gives the total stresses, (50) plus (51). The results are plotted in Figure 8 for $t = 24$ hours.

On the assumption of a brittle-type failure, the stresses at the edge of the hole are of greatest interest. The variation of these stresses with time is shown in Figure 9. Since the critical shearing stress, $\frac{\sigma_r - \sigma_z}{2}$, governs actual wall collapse on this theory,[2] it is also shown in both Figures 8 and 9.

With time, all stresses approach the values given by equations (51), σ_r

TABLE 2

Thermal Stresses, psi

	Distance from Center of Hole, Feet	TIME, HOURS			
		24	120	240	720
σ_r	0.250	0	0	0	0
	0.375	2440	2390	2270	1765
	0.500	3040	2930	2780	2170
	0.625	3160	3010	2800	2200
	0.750	3110	2990	2860	2230
	1.000	2930	2820	2680	2100
	1.250	2720	2630	2500	1980
	2.500	2060	2000	1950	1540
σ_θ	0.250	10000	9650	9110	7100
	0.375	5760	5510	5190	4075
	0.500	4050	3910	3680	2890
	0.625	3190	3100	2920	2350
	0.750	2690	2650	2420	1980
	1.000	2120	2040	1960	1590
	1.250	1790	1800	1660	1360
	2.500	1160	1140	1105	960
σ_z	0.250	10000	9650	9110	7100
	0.375	8200	7900	7460	5840
	0.500	7090	6840	6460	5060
	0.625	6350	6110	5800	4550
	0.750	5800	5640	5300	4210
	1.000	5050	4860	4640	3690
	1.250	4510	4440	4160	3340
	2.500	3220	3140	3020	2500

TABLE 3

Stresses Due to Overburden and Fluid Pressure

Distance from Center of Hole, Feet	STRESSES PSI.		
	σ_r	σ_θ	σ_z
0.250	−8000	+1330	−10000
0.375	−5410	−1250	−10000
0.500	−4500	−2150	−10000
0.625	−4080	−2580	−10000
0.750	−3850	−2810	−10000
1.000	−3620	−3040	−10000
1.250	−3480	−3190	−10000
2.500	−3380	−3280	−10000

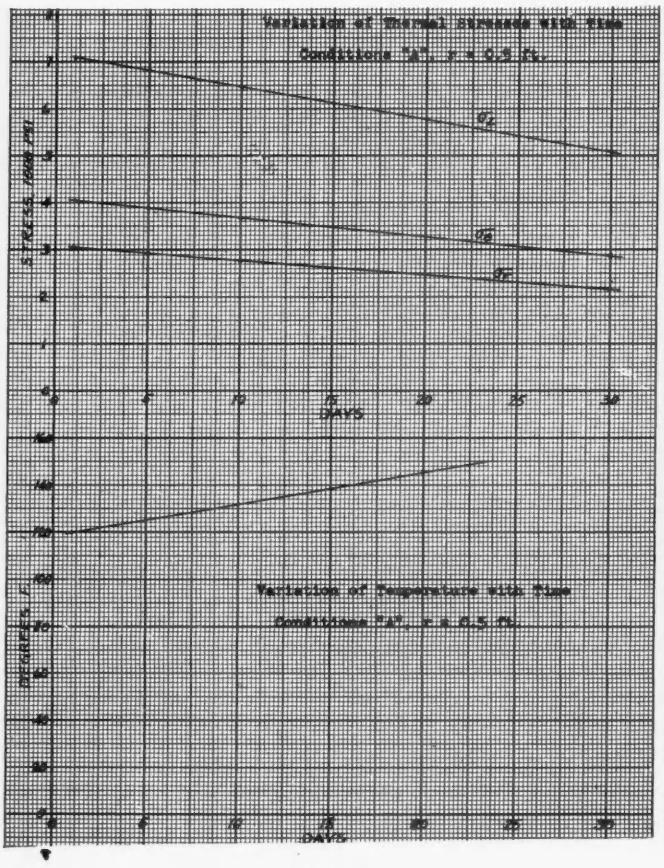

FIGURE 6

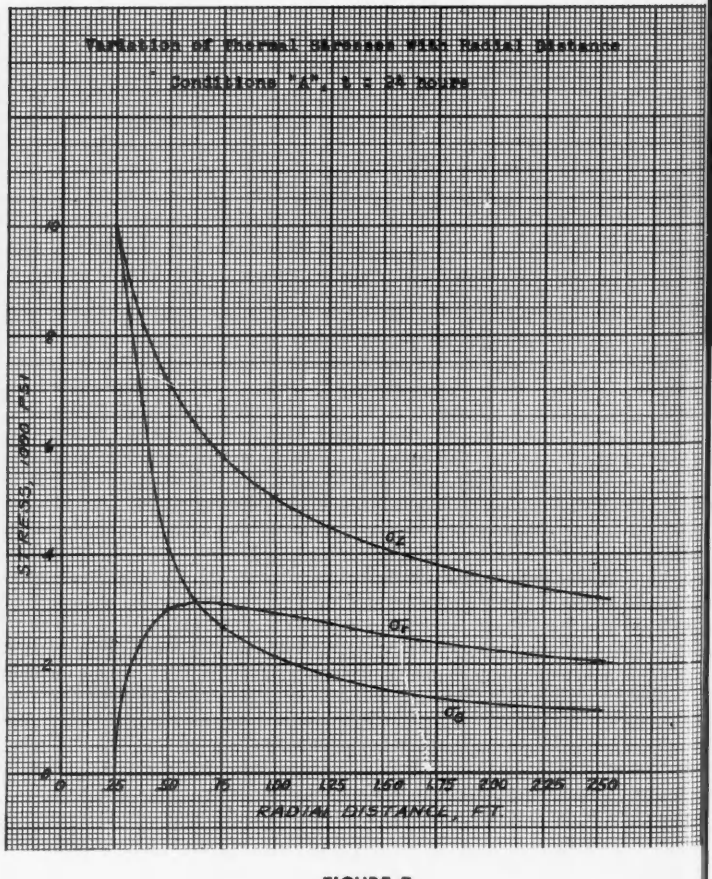

FIGURE 7

It doesn't have to be this way...

YEAH, PETE, UP ALL NIGHT AGAIN... TWO MORE WELLS ARE DOWN AND OUR PULLING UNIT PICKED THIS TIME TO THROW A ROD... CAN'T GET A CONTRACT UNIT UP HERE FOR 3 DAYS. DIVISION OFFICE IS ON OUR BACK BECAUSE WE HAVEN'T MADE OUR ALLOWABLE IN FOUR MONTHS... IF WE PULL THROUGH THIS SPELL, I'M GOING TO BED FOR A WEEK.

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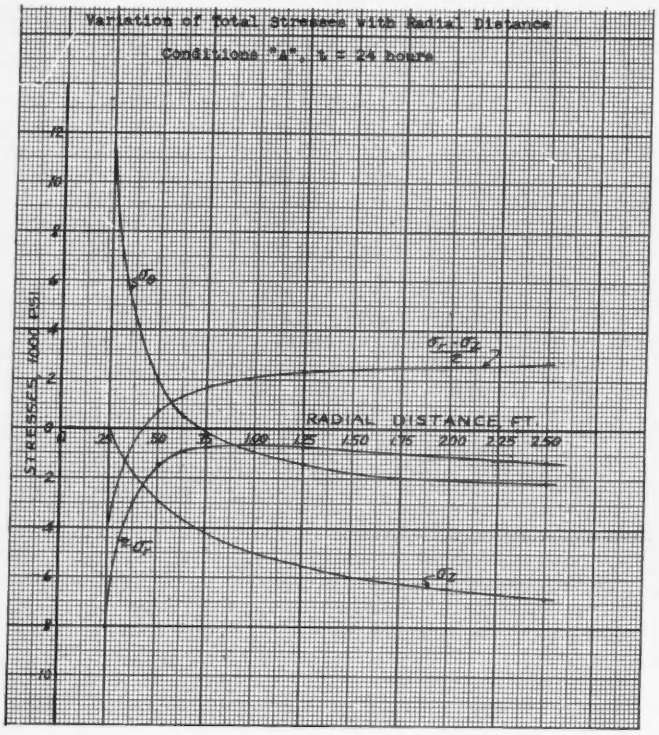

FIGURE 8

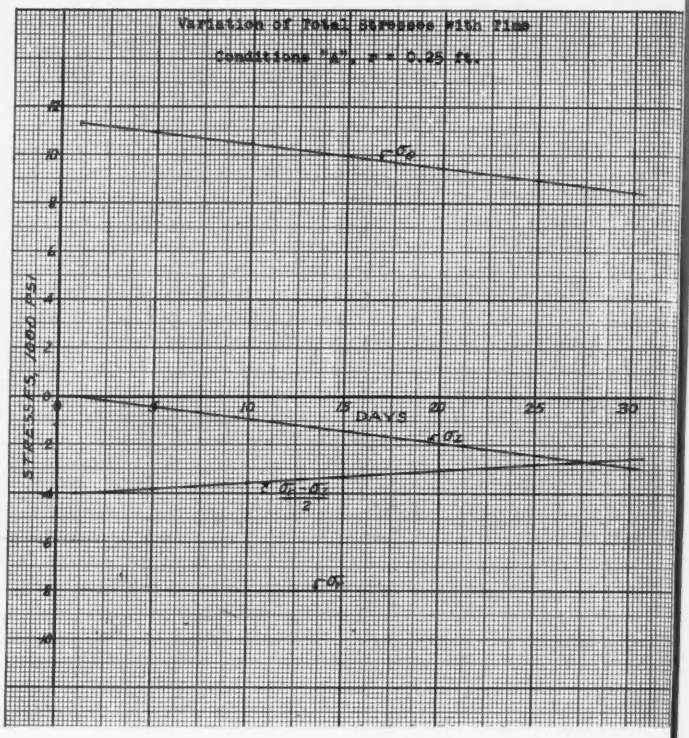

FIGURE 9

(except at r = a) and σ_z increasing, but σ_θ and the critical shear decreasing. The circumferential stress, σ_θ, has a very high tensile value, indicating the early formation of vertical cracks. If this takes place, the assumption of compatibility on which the stress equations are founded is violated and strict applicability of results depending on time is made questionable. The critical shear also decreases with time, which throws doubt on the brittle failure theory of wall collapse, since any disintegration at the bit itself is of no moment and wall failure occurring after the bit has passed is presumably a time-dependent phenomenon.

If a plastic state of stress exists around the hole, it may yet be found that the increases in σ_r and σ_z, if these trends occur in the plastic state, cause deformations increasing with time. Another and possibly more promising angle for attack is that rock is a highly viscous or visco-elastic material which flows with time. Salt and shale are known to have visco-elastic properties. Geologists have described the slow movements of the earth's crust on this basis,[16] though the computed coefficient of viscosity was probably too high to permit deformations of any magnitude in such a short time project as an oil well. Confining pressure, temperature, and the presence of solutions, however, all have important effects on such coefficients.[14,15]

Another result of the thermal elastic solution worth looking at is the very small compressive stress obtained for σ_r. If the internal pressure in the hole were reduced sufficiently, a radial tension would exist—a condition evidently tending to promote wall collapse in view of the weakness of rock in tension. If, however, this stress is calculated for the extreme case where $p_i = 0$, its maximum value appears to be about 650 psi in tension ($r = 0.375$, $t = 24$ hours); and σ_r decreases with time when it is tensile. Since it is unlikely that the fluid pressure would ever fall to zero, this incipient radial tension does not appear to have much significance.

The greatest practical importance of the results of this investigation lies in the implication that, since the thermal stresses are large, rock stresses, and therefore wall collapse, may be controlled by controlling the temperature of the drilling fluid—where this would not adversely affect the thixotropic, wall-building, or other essential properties of the mud.

TABLE 4

Total Stresses, psi

	Distance from Center of Hole, Feet	TIME, HOURS			
		24	120	240	720
σ_r	0.250	−8000	−8000	−8000	−8000
	0.375	−2970	−3020	−3140	−3645
	0.500	−1460	−1570	−1720	−2330
	0.625	− 920	−1070	−1200	−1880
	0.750	− 740	− 860	− 990	−1660
	1.000	− 690	− 800	− 940	−1520
	1.250	− 760	− 850	− 980	−1500
	2.500	−1320	−1380	−1430	−1840
σ_θ	0.250	+11330	+10980	+10440	+8430
	0.375	+ 4510	+ 4260	+ 3940	+2825
	0.500	+ 1900	+ 1760	+ 1530	+ 740
	0.625	+ 610	+ 520	+ 340	− 230
	0.750	− 120	− 160	− 390	− 830
	1.000	− 920	− 1000	− 1080	−1450
	1.250	− 1400	− 1390	− 1530	−1830
	2.500	− 2120	− 2140	− 2175	−2320
σ_z	0.250	0	− 350	− 890	−2900
	0.375	−1800	−2100	−2540	−4160
	0.500	−2910	−3160	−3540	−4940
	0.625	−3650	−3890	−4200	−5450
	0.750	−4200	−4360	−4700	−5790
	1.000	−4950	−5140	−5360	−6310
	1.250	−5490	−5560	−5840	−6660
	2.500	−6780	−6860	−6980	−7500

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REFERENCES

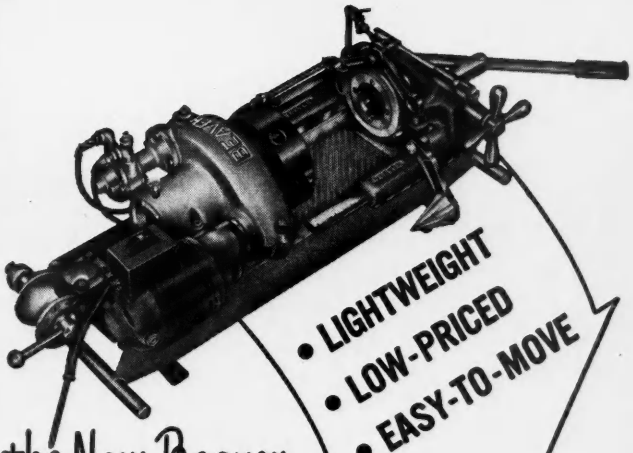
[12] Timoshenko, S., *Theory of Elasticity*, New York, McGraw-Hill, 1934; p. 370.

[13] Marks, L. S., ed., *Mechanical Engineers' Handbook*, New York, McGraw-Hill, 1941.

[14] Birch, F., Schairer, J. F., and Spicer, H. C., eds., *Handbook of Physical Constants*, Geological Society of America, Special Papers, No. 36, 1942.

[15] Nettleton, L. L., "Recent Experimental and Geophysical Evidence of the Mechanics of Salt Dome Formation," *AAPG Bulletin*, vol. 27, 1943; p. 51.

[16] Hubbert, M. K., "Strength of the Earth," *AAPG Bulletin*, vol. 29, 1945; p. 1630.



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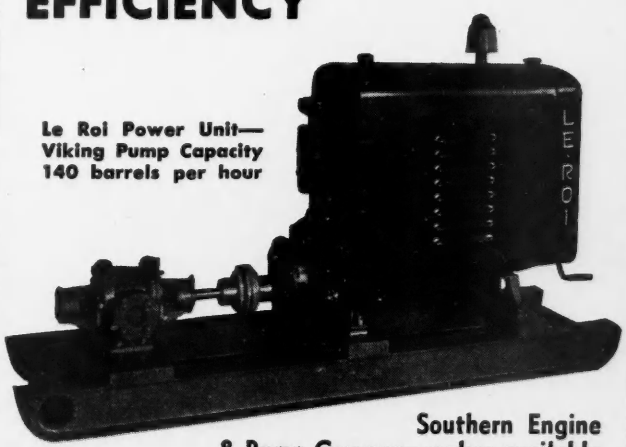

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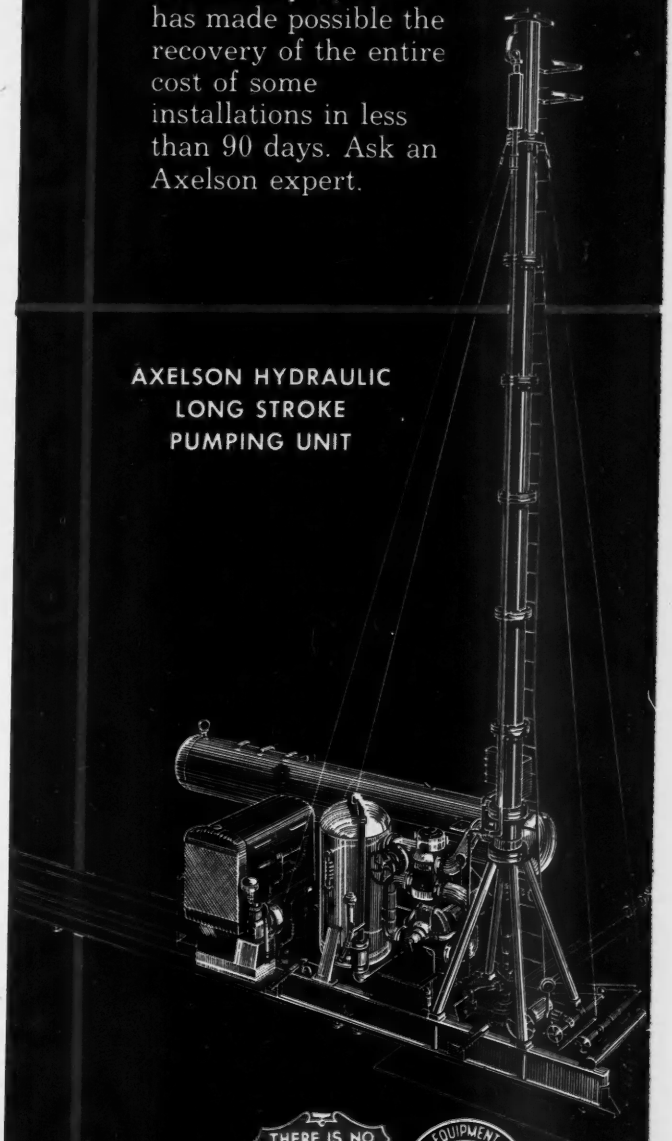

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Thief Strata Analyses Reveal Energy Losses

By F. R. COZZENS

Field Foreman, Equity Oil & Gas Company, Stockport, Ohio

THE economic appraisal of a secondary oil reserve is basically determined by the behavior of its wells, and on many projects the problematic wells are neither inputs nor producers, but "leakers" which retard the movement of an oil-head by robbing the sand of inducted energy.

Reservoir leakage, or the escape of driving power into thief formations, is a complex condition that originates treacherously and gathers momentum as operations develop. Early detection is difficult, and on leases where its effects appear negligible, leakage is often in progress through lateral flow-trends or from zones not directly associated with the production of oil. However, leakage from one zone or horizon over a course of weeks or months invariably prepares a route for leakage from another, and once a thief avenue is opened, induction volume on the inputs starts rising, yet the recovery process in that immediate area slows down. Every barrel or cubic foot of compressor energy thus wasted adds an equivalent amount to the cost of producing oil, and cases are not exceptional where much of the oil-head itself was pressured into thief formations and lost. Any diameter drill bore, plugged or unplugged, which has penetrated a stretch of repressured sand is capable of becoming a leaker providing a pressure-escape route can be channeled into the annulus.

Generally, the offenders are open abandonments, inactive producers, or wells which have been damaged beyond repair, although not infrequently carefully supervised plugging jobs become leakers because the plug-seats (sand top) have been cracked or shattered accidentally in well-shooting practices. Some pressure escapes through unplugged pockets beneath a pay sand zone, and in certain types of sands, especially in strata that are lensing out, pressure pulsations are often sufficient to unseat plugs and packers which are not backed up with cement. This action occurs most frequently in water drives. Due to more favorable physical conditions, the great majority of leakage trends extend upward, yet factual evidence is rarely discovered at the mouth of an offending well. Because of obstacles, such as cavings, bridges, etc., commonly encountered along an annulus, escaping energy seldom reaches the surface in detectable quantities, but generally fans out into porous and conglomerate strata at various depths below it.

Escape Points

Escape points into such strata would also be extremely difficult to detect were it not for one significant characteristic. During the infiltrating process, the receptive strata becomes more or less infused, not only with the repressuring agent itself, but also with sedimentary materials which the agent has elevated from the reservoir. These materials, principally waxed oil, smut, salt, and mineral deposits, are authentic evidence that pressure is escaping into that particular stratum, and can be readily detected by coring or by the analysis of drainage when a well in process of drilling reaches that depth. Within an average radius of 100 feet from a leaking annulus, such elements or deposits are generally of sufficient density to be easily recognized in drill-cutting samples taken and examined at the derrick floor, and this procedure is now becoming a predominant factor in tracing reservoir leakage in many eastern repressured fields. Derrick floor samples, however, are not intended to replace laboratory analysis, but are utilized in field practice to reveal leakage, and to determine whether more elaborate analysis is necessary. The depth at which foreign elements or deposits are first noticed in a new drilling reveals with considerable accuracy the length of open bore in the offending annulus, and by calculating its radial distance in proportion to this depth, it is often possible in field practice to spot an obscure leaker, 1000 or more feet above the sand from which energy is escaping.

The strata analysis method of detecting reservoir leakage is particularly adapted to the now generally approved practice of drilling strategic input wells first, then inducting the repressuring agent for some time before the producing wells are drilled. Leakage normally develops as the pressure-head builds up, but unless extreme, is rarely observed in thief formations until repressuring has continued for at least six months. Assuming that all known leakers have been plugged or repaired, the operator's initial procedure during the waiting period is to obtain practical working knowledge of strata most likely to steal or receive energy between the surface and the top of his producing sand. Authoritative data are usually obtainable from former owners of the leases, or from drillers who have operated extensively in the area. From these and similar sources can be learned the depth, color, average thickness, and other physical characteristics of such stratum, along with factual data relative to its behavior under normal drilling conditions.

Thief formations, or strata capable of absorbing pressured air, gas, or water, are less numerous than is commonly believed. The average number in many areas being less than four per 1000 feet of drilled hole. Pressure leakage evidence is rarely revealed in limestone, clay beds, or in densely consolidated shales unless such strata have been creviced and fissured by eruptions, or by well-shooting practices. Receptive strata, or formations most capable of receiving repressuring agents, are coarse sandstone, coal, gravel, or conglomerate structures which are loosely cemented or ex-

tremely porous. Especially receptive are coal veins or seams (lenses) of slate in the immediate vicinity of a repressured sand.

Once the operator is made acquainted with susceptible strata common to his territory, he lists each formation in relation to depth and thickness upon a chart which becomes a part of the drill-record log when a new well is started. Drilling crews are instructed to investigate and report any odd behavior, such as freak caving, air or gas pockets, or the presence of sludge, at any of the designated stretches of hole en route to the producing sand.

When the first susceptible formation listed on the chart is penetrated to its base, samples of the cuttings are caught from the bailer in a drum or grease-free bucket. The cuttings are washed thoroughly in clean, fresh water then allowed to remain immersed in water for 30 minutes. Gas, or air-gas, if present, will rise to the surface as bubbles when the cuttings are stirred after immersion.

Bubbling or hissing can often be heard in the annulus after the fluid column has been partially bailed down. Air energy escaping from the reservoir will also cause the sample water to become frothy. Where oil, or oil-smut is present, but not in quantities sufficient to appear on the water, its odor can be detected by inserting a piece of heated metal into the fluid in the sample bucket. This procedure also brings to the water's surface the brilliant and multi-colored hues of iron oxide, scale, and mineral salts, although a more positive identification is made by sprinkling sample water upon litmus paper, which turns red or mottled when in contact with most reservoir minerals.

If water is being used as the repressuring agent, a soapy scum, resembling so-called floating-sand, may appear partially suspended in the sample bucket, and will give off a greasy odor when placed upon heated metal. Water leakage will also cause cable-tool drill-cuttings to become soft and mushy. Another characteristic frequently noticed in drilling such strata is that the water content, particularly in the upper zones, is excessive, and that the fluid column will rise and fall in the annulus during the resting period. Water being pressured into the annulus from an old abandonment will produce a rank, stagnant odor when the receptive stratum is tapped, and will appear foamy, and of a black to dark-greenish color in the sample bucket. Such water is usually salty. Where a flooding water

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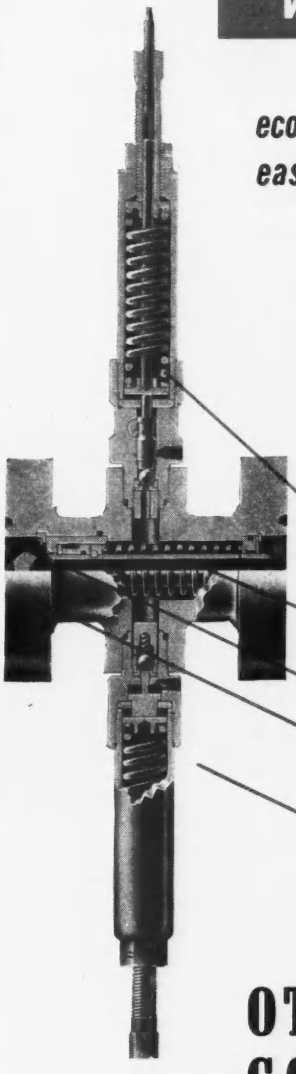

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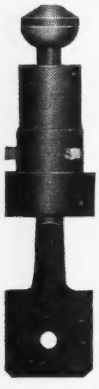

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with a pH less than 7.0 is being used, its leakage can often be detected by chemical agitation when an alkali, such as common soda (bicarbonate) is dropped in the sample water. Wax or paraffin deposits can usually be identified by examining segments of the wetted cuttings under a reading glass.

If at the conclusion of the testing period, no positive evidence of leakage is discovered, that particular stratum is marked off the chart, and drilling proceeds until the next susceptible formation is encountered and penetrated to its base. Similar bucket-testing procedures are again carried out, and this routine is adhered to rigidly until the drill's arrival at the top of the producing sand. If all susceptible thief-strata above it have proven free of evidence, it is conceded that no serious degree of leakage exists within a radius of 100 to 150 feet from that location. The new well (if a producer) then becomes a unit in the repressuring pattern. The field-testing practice, under the same routine is resumed on each successive well until the entire project has been drilled and patterned.

Only upon exceptional leases do all new drillings prove negative, and as soon as leakage evidence is definitely established, steel-line measurements are made from the mouth of the annulus to the base of the infused strata. Position and thickness of the strata are recorded on the chart, along with a brief description of the evidence found. A radius of 150 feet around the annulus is then marked off, and within that circle or area an intensive search is made for the offending leaker. Unsuspected or forgotten abandonments are generally detected by dips or depressions in the surface soil, cinders, the greasy outline of casing or drive-pipe, or by fragments of old drilling equipment. When the site is discovered, the linear measurements previously taken on the new annulus will reveal, very closely, the footage of earth or fill which must be removed before the escape route is reached.

Earth burden or fill, 20 feet or less in thickness, can be removed more economically by bulldozer or power shovel, although it is usually found more advisable to erect a cleanout rig over the site. Once a direct avenue is opened through the old bore, the manner of plugging is at the operator's discretion. Generally, an old annulus is reopened to a diameter through which a tapered plug can be seated in the top of the producing sand, the plug being backed up with 15 to 25 linear feet of cement slurry, and the remainder of the annulus filled to the surface with wetted clay. Other, but less effective methods of closing an annulus are by using explosives (dynamite or nitroglycerin); applications of heated water, or heat-generating chemicals and water (to induce caving); or by bridging the bore at strategic points, and filling the space between bridges with gel-type cement.

If active producing wells are included within the suspected radius, the linear measurements which were previously taken on the new annulus (where pressure escape was detected) will often reveal a leaky packer or a damaged section of casing in one or more of those producers at or near the designated depth. Such measurements may also reveal that leakage is occurring around the outer string of casing, or between strings. This evidence will be further confirmed if air or gas bubbles appear when the space around the casing or between casings is filled with water. Mechanical repairs are generally necessary to stop such leakage, and all replaced pipe, or new packers, unless especially designed for the job, should be backed up with cement slurry or plastic compound. Other troublesome leakers develop quite frequently from dormant or inactive producers from which the tubing and rods have been long removed, and the casing left in the annulus for possible future use. Even though such casing is closed at the top with a pressure-proof head, corrosion of submerged sections will often provide avenues for energy escape. All inactive wells being retained for probable future use should be processed by seating drillable plugs in the sand top, and spraying the casing's interior surface with a protective compound before the head is applied. Lastly, any inputs operating within the area of suspicion should be checked closely for damaged pipe, leaking valves, or packers.

To expedite the discovery of reservoir leakage into thief formations, operators in several eastern areas are now using tracing additives, such as helium gas, volatile oils, and dyes, with considerable success. These agents are fed or lubricated into the repressuring medium through the induction lines near an input, and because of greater buoyancy, they are capable of being elevated from the reservoir into receptive strata much more rapidly than are sedimentary materials. Helium gas is the tracing

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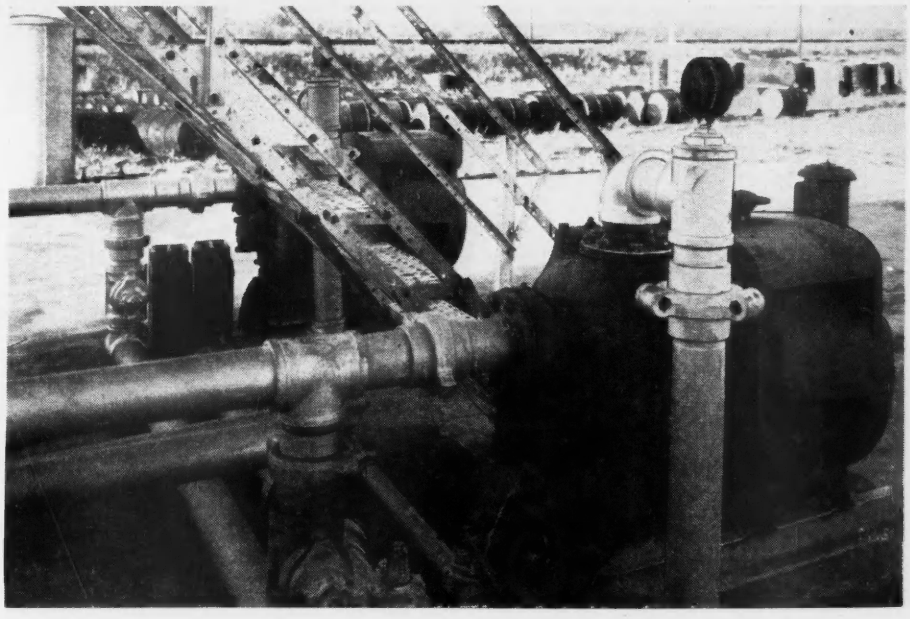

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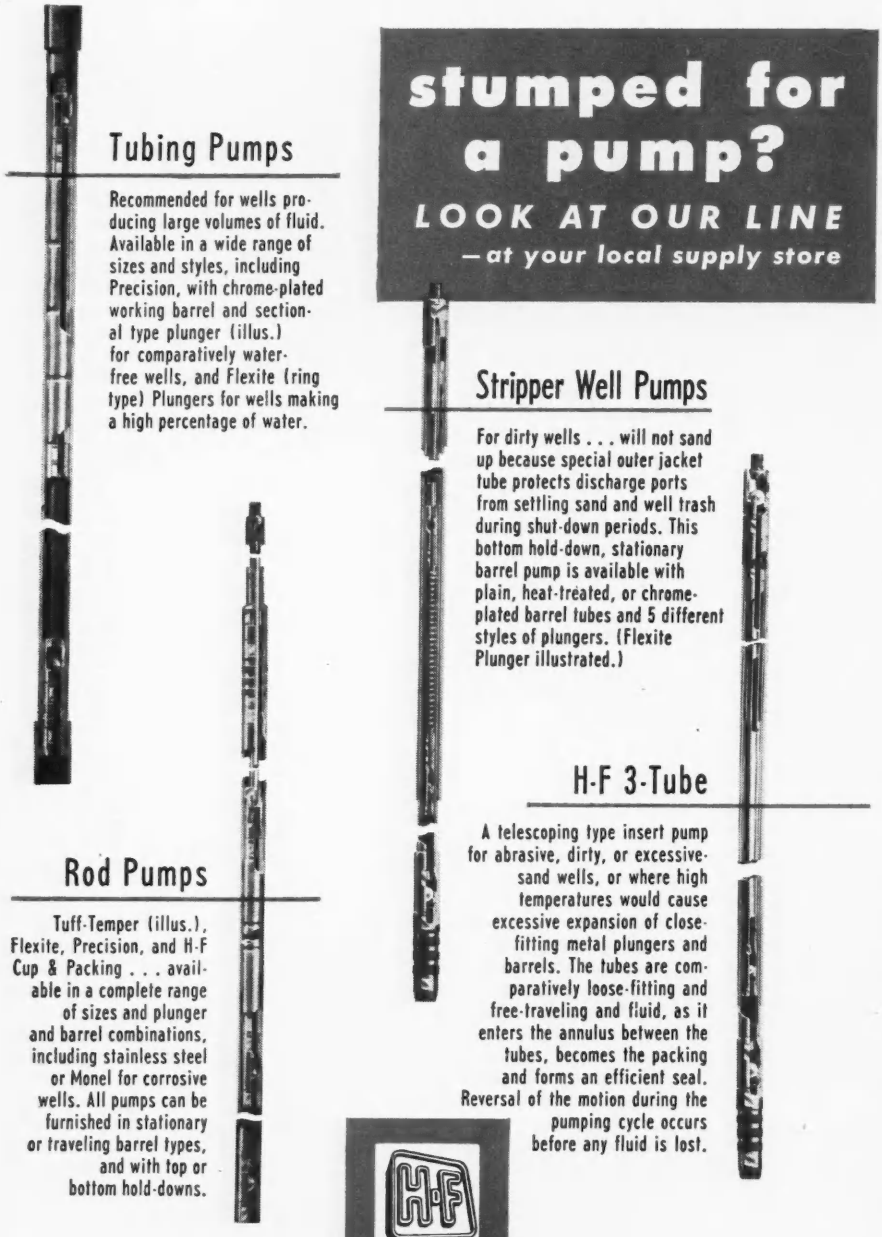
agent most widely approved where natural gas is being used as the repressuring medium. Volatile oils or vaporous liquids, such as amyl acetate (banana oil), methane, and naphthene compounds, are utilized mainly in air drives. Preparatory to the appearance of gases or vapors in a well undergoing tests, a drill-nipple is tightly seated in the mouth of the uncased annulus. The nipple is plugged at the top, and is provided with a valve, through which samples of the agents are taken for analysis. Dyes, particularly Venetian red or other bright, conspicuous colors, are often used as tracing agents in water floods. Bucket samples taken at the derrick floor usually reveal the appearance of a dye without more elaborate analysis. A few far-sighted operators now make it a rule to place a liberal quantity of dyes in the shot-hole of each abandonment before plugging so as to facilitate detection of future leakage which might occur therefrom. Another recent procedure for speeding up the tracing of leakage is the planting of dyes in surrounding producers which are back-flowed frequently while a new well is in process of drilling.

The degree of evidence of energy escape into a new drilling reveals not only the proximity of the leaker but also, potentially, the economic future of the new well itself. If leakage is excessive, and repair costs exorbitant, it may prove more expedient to abandon the partially completed new annulus and relocate. This may require rearrangement of the pattern, and the position of a discovered leaker may likewise alter the spacing of producing wells.

Since producing wells in a pattern arrangement are generally spaced 75 to 150 feet apart, it can be readily seen that the imaginary areas for investigation which encircle each new drilling will often overlap so that practically every foot of acreage is examined for leakers by the time all patterns are drilled. Pattern completion will usually conclude the rounding up of all major leakers so that necessary pluggings and repairs can be made before much of the oil-head is wasted.

The routine of testing thief strata for reservoir leakage does not complicate the drilling schedule in any manner, and becomes quite simple after being practiced on a few wells. Its simplicity, in fact, belittles its importance, because the effective closure of one major avenue of energy escape often results in a higher and more uniform pressure buildup over an entire pattern. Field testing effectiveness is not confined to any particular type of stratum, nor is it limited to wells of any restricted depth. It is now known that pressure escape routes from a reservoir into receptive strata follow rather closely a general directional trend, and that some degree of energy is escaping constantly through these trend-courses from every repressured sand.

The economic status of a repressuring program often hinges upon the early detection and effective closing of as many of these trend-courses as possible. Otherwise, induction rates are overbalanced, and operating expenses rise. It therefore becomes evident that each detected leaker plugged or repaired, increases efficiency, stimulates driving force, and helps stabilize the process of producing oil.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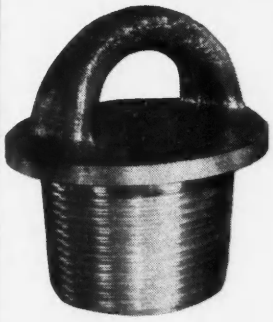

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How to do it! PRODUCTION HINTS

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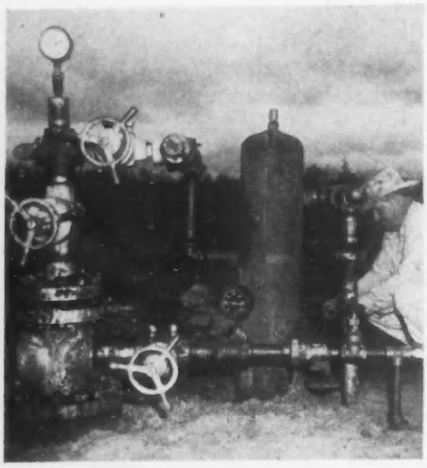
HOW TO—

Remove Fine Sand From Flow Stream



Wells that produce very fine sand from unconsolidated formations present a serious problem to production personnel. Particularly annoying is the abrasive action of the sand in cutting out chokes, flow lines, etc. To control this situation effectively, one producer designed and installed a simple sand trap. Experience on this lease was that wells which produced through larger chokes resulted in less sand problems. To cause the sand to drop out in a trap, two chokes were installed on the trap. One choke was placed in the flow line upstream of the trap while the second was installed on the downstream line. The upstream choke was the smallest size which experience proved resulted in little cutting action and did not clog up the line. The downstream choke was the size necessary to maintain the well at its allowable production, and was, therefore, smaller in size than the upstream choke.

The trap itself was made from a section of 12-inch pipe which had been orange-peel welded closed at either end, with a two-inch collar welded to the upper end to accommodate a pressure gauge. The inlet line was connected to a 2½-inch collar welded to the trap at a point near its middle. This connection is shown at the left of the trap. The fluid outlet was similarly connected at a point approximately 12 inches higher so that space was provided for dropping out the sand. Another connection at the bottom of the trap made it possible to blow the accumulated sand out of the trap and into a sump. The device has proven satisfactory in extending the useful life of the regulating choke and saves many stock tank and separator clean-out jobs.

HOW TO—

Construct Adaptable Stairway for Tanks

A shop-made stairway of neat and efficient design which is ideally suited to the various miscellaneous tanks, loading racks and platforms around the lease, is illustrated. Treads are made by welding tank channel material to the sides of rectangular pieces of expanded metal. Short pieces of sucker rod bent into a right angle form the risers, the treads being welded to them as shown.

One of the advantages of this type of construction is the fact that, if necessary, individual treads and risers may be made up in quantity in the shop, then brought out to the field for fitting to the particular jobs at hand. The stairway is sturdy, has skid-proof treads, and can be constructed largely out of materials generally available in the average oil field welding or machine shop.

HOW TO—

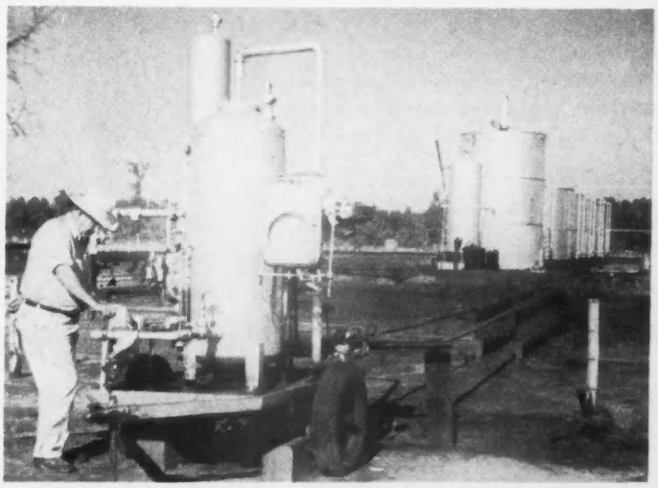
Fabricate Efficient Plug Valve Wrench

A simple wrench for use on plug valves where the plug is held in place by a hexagonal nut on the bottom can be fabricated in short order by the shop welder. This wrench, designed for use by the pumper at the tank battery, is constructed so that one end fits the square shoulder of the plug for opening or closing the valve. The hexagonal end fits over the large, flat hex nut securing the plug in place.

The complete wrench assembly can be cut from a piece of scrap ⅜-inch boiler plate steel usually found around the welding shop. An opening is cut the size of the squared shoulder on one end and a hexagonal hole on the other at a distance of about one foot from the box end. Both holes are outlined and the weight of the tool kept as low as possible.

When one such wrench is fabricated, it may be used as a pattern for a second, and sufficient wrenches can be made so that one can be placed at each tank battery equipped with this type plug valve. Their unusual size makes them unsuitable for other work, and the pumper is assured of keeping one around the battery for running oil when ready.

HOW TO—Connect Portable Checker



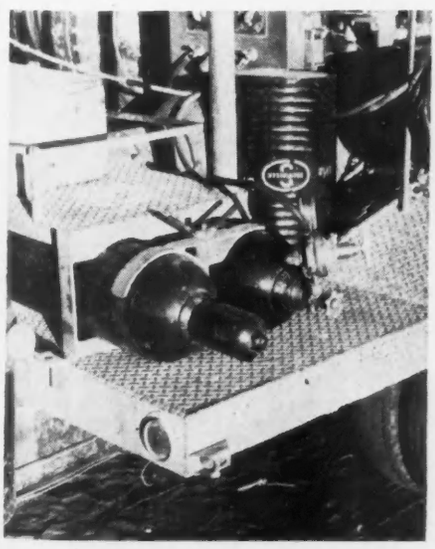
On leases where well checkers are used to periodically gauge production and gas-oil ratios of individual wells, one company uses two well checkers. One is equipped with flexible hose connections in the conventional manner, and the other equipped for straight pipe connections as illustrated.

A portable well checker is used on small, isolated leases, while the one shown is blocked up to preserve the tires, and provide a more solid foundation so the piping can be made up tightly to the inlet and discharge lines. Headers from the tank battery flow line manifold are extended to the outside of the battery enclosure as shown, and connected to the well checker.

Where high gas-oil ratio wells are produced, one well is kept on the well checker shown each day, and the day's production is indicated in writing on the fluid meter chart, together with the water production. Each chart can then be sent to the engineering department for calculation of ratios, etc. Choke sizes can then be adjusted to produce the most favorable ratio, and wells which tend to load up can be detected and larger chokes installed until these wells recover. Since there are many wells to be checked on this lease, the checker is in use most of the time.

Tires and wheels are allowed to remain on the unit so that when it is necessary to run annual tests on wells on other leases, the blocks can be removed and the solid connections replaced with hose connections for hookup to individual wells.

HOW TO—Mount Bottles on Truck



A convenient method of carrying oxygen bottles on the field welding truck, one that provides complete accessability and at the same time keeps the center of gravity at as low a point as possible, is seen in the installation shown. A low steel box-like framework, decked over with non-skid floor plate material, is mounted athwart the truck bed, the clearance being just sufficient to allow the bottles to be slipped beneath it and clamped in place with the yoke device visible in the photograph. In addition to keeping the center of gravity at a low point, the method provides a wide floor area back of the truck cab on which heavy tools, boxes of supplies or other equipment can be carried conveniently. Pressure regulators, being at a low level, are convenient to the welder when he is working on the truck bed or on the ground beside his truck.

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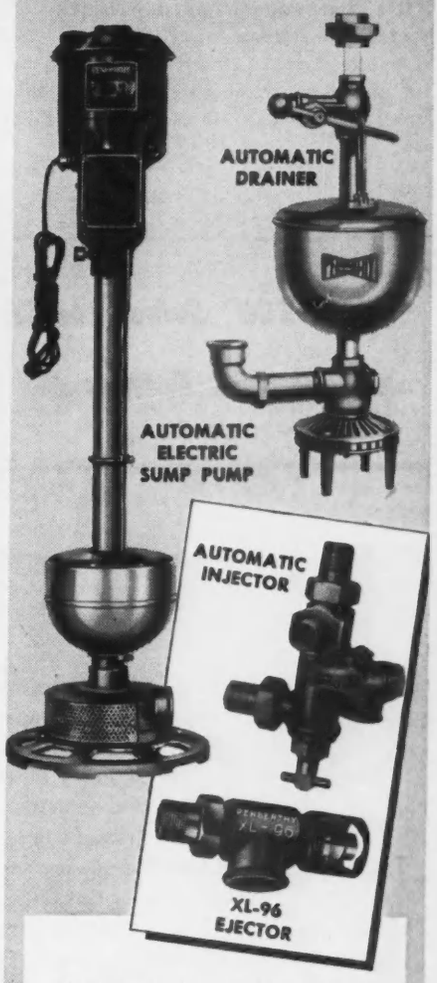
Products



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3277-A

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Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

HOW TO—

Use Discarded Chain To Brace Pull Pipes

On a centrally powered jack plant installation, where a number of pull lines radiating outward from the power may be grouped fairly close together, it is oftentimes desirable to construct a single, sturdy overhead pull line support instead of installing a number of individual holdups, one for each line. One operator employs for this purpose overhead supports made of salvaged 8- or 10-inch casing.

Installed as illustrated, the support has suspended from it a number of lengths of heavy rotary chain. The pull lines are run through the bottom links of the chains. The chains provide a means of adjusting the line upward or downward, depending upon the terrain at that point and the amount of wear that occurs. Another advantage of this overhead support is the fact that new wells can be hooked up readily, or old pull lines shifted to one side or another, merely by positioning the chain hold-ups at the desired points on the overhead beam.

BORASCU* destroys weeds and grasses at a fractional cost of most methods such as hoeing, etc. You can enjoy substantial savings by using BORASCU* about *your* tank batteries, well sites, heater units, and rod lines, just as many other petroleum producers are now doing, for BORASCU* does destroy most vegetation and prevents future growth for 12 to 24 months, or longer, when correctly used! Borascu* and Concentrated Borascu are applied dry . . . if spray equipment is to be used, we suggest our new, improved Polybor-Chlorate for it is readily soluble and safe to use. Yes, it is nonfire-hazardous although it combines the plant-destroying powers of borates and chlorate . . . gives quick knockdown of tall standing vegetation. See these chemicals demonstrated on your property under your conditions without any obligation . . . act now!
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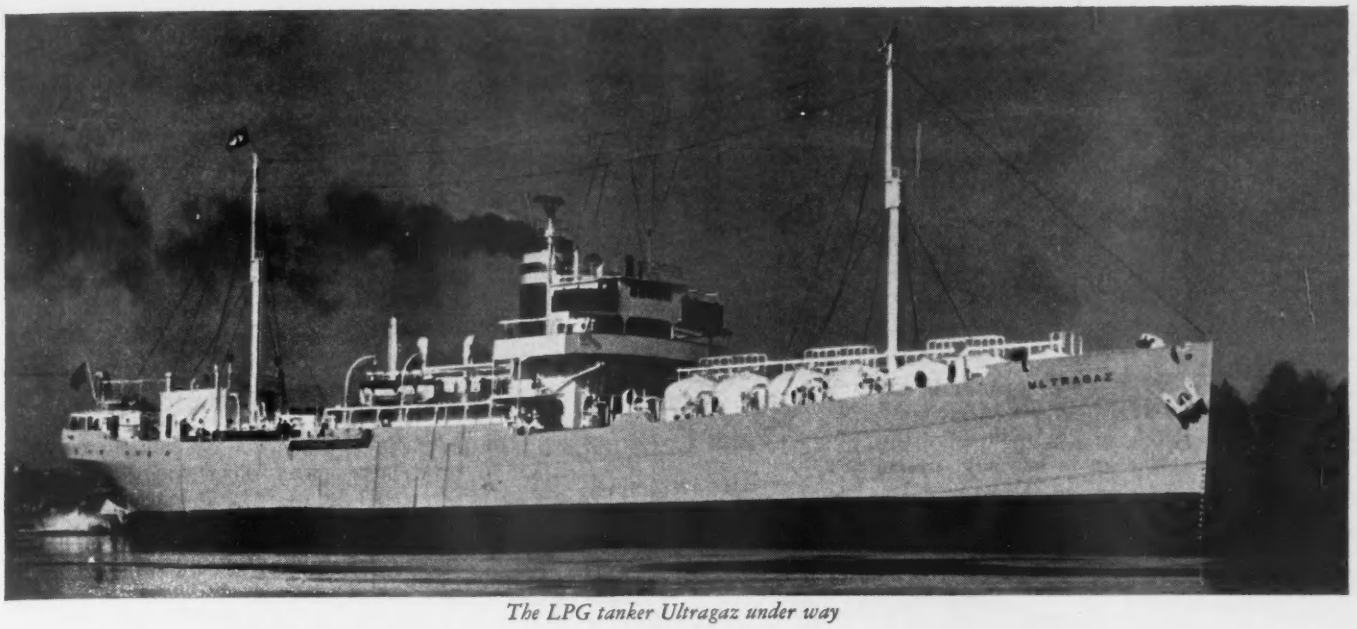
HOW TO—

Speed Cooling of Circulating Water

An inexpensive method of improving the cooling rate of circulating water used in single-cylinder gas engines commonly used on pumping wells is illustrated. The operator, having on hand some used and discarded floodlight reflectors, rigged up the spreader device shown. It effectively aids the rate of cooling the relatively small volume of water circulated. The heavily-enamelled surface of the reflector is ideally suited to this type of service and will outlast spreaders made of ordinary painted or galvanized material.



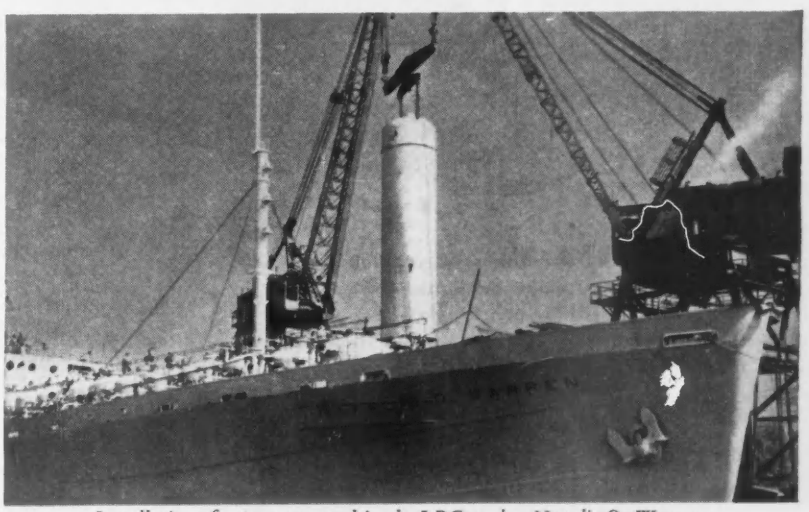
The LPG tanker Ultragaz under way

Liquefied Petroleum Gas Tankers by BETHLEHEM for MAXIMUM Economy Efficiency Safety

The *S. S. Natalie O. Warren* and the *S. S. Ultragaz,* converted at Bethlehem's Beaumont Yard from dry cargo vessels to liquefied petroleum gas tankers, represent the most economical and safest means yet developed for the transportation of bulk propane and butane gases.

They also reflect Bethlehem's ability to design and construct or convert varied craft for the most efficient mass movement of special liquid cargoes over *the oceans or on inland waterways.*

If you are a bulk shipper of special liquid cargoes we would be pleased to show you some of the economic, safety, and control advantages of transportation by specialized ships and barges. Your inquiry will be welcomed by Bethlehem —the nation's outstanding pioneer in the development of economical waterborne transport mediums for petroleum and its products.



Installation of a pressure vessel in the LPG tanker Natalie O. Warren

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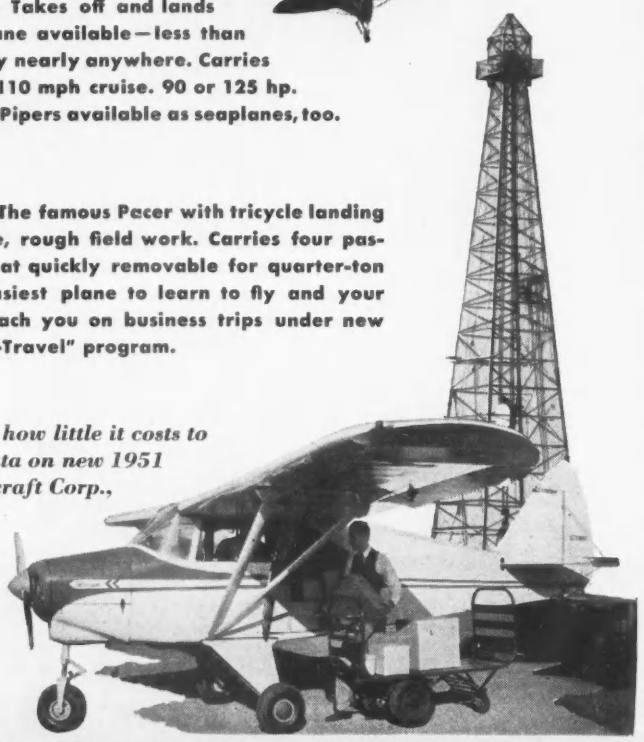
For full information on how little it costs to fly a Piper and latest data on new 1951 models, write Piper Aircraft Corp., Dept. L-I, Lock Haven, Pennsylvania.



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"TRAVEL FASTER, CHEAPER BY PIPER"

PRODUCTION HINTS

HOW TO—

Improvise Simple Paraffin Scraper

When one Gulf Coast operator encountered difficulty in getting a pump down the tubing due to paraffin deposits, he improvised a cutter or scraper as shown. The device is made of a discarded two-inch section of a working barrel of the same size as that to be run into the well. It is placed on a short "pony" rod with a sleeve so that the section slides back and forth over the short rod. The sleeve is placed on the rod in a machine shop by splitting the section of working barrel and also a ¾-inch nipple the same length after placing the ¾-inch nipple over the rod and welding the sides up, the working barrel sleeve is placed over the pipe and both of

them are welded together with sufficient space in the weld to permit passage of paraffin.

This scraping device is placed on the pulling unit, and when trouble in lowering the pump to bottom is encountered, or when a flowing well is paraffined up, this device is run on sucker rods or ahead of a sinker bar on a swab line. With the sleeve free to slide up and down on the rod, a jarring action can be obtained when the scraper encounters a tight section in the tubing. The weight of the rods is used as a driving force to push the cutter through the tight section. The pony rod permits the rods or wire line to be raised and dropped to provide the driving weight. When enough paraffin has been removed to permit the pump to be lowered to bottom, the installation can be made without difficulty.

To help you lengthen equipment life and save critical materials . . . . . .

Some important facts about

GALVANIC CORROSION

and how you can control it

With strict conservation of basic defense materials again the order of the day, this brief discussion of bi-metallic corrosion may save oil men a few unnecessary headaches

When two dissimilar metals are coupled in a corrosive liquid – brine, for example – one metal is often attacked by corrosion at a faster rate than usual.

The second metal may remain free from attack. Or it may be corroded at a slower rate than usual.

This type of corrosion is known as "galvanic corrosion."

What to look for

Before blaming galvanic action for corrosion in your equipment, you should first determine whether these three conditions exist:

1. **Are the metals different?**
2. **Are they surrounded by an electrolyte?**
3. **Are they in electrical contact through a metallic path?**

A "yes" answer to all three questions should send you to the "Galvanic Series" chart reproduced at the right. Here the metals are listed in the reverse order of their "nobility" or resistance to galvanic corrosion.

Galvanic corrosion usually results in a higher rate of corrosion of the "less noble" metal, and protection of the "more noble" metal.

How to use the chart

Notice how the metals are grouped. Any metal in one group can safely be used with any other metal in its own group. When you start mixing metals from different groups, however, you may run into serious galvanic corrosion of the metal higher on the list. And the further apart the metals stand, the worse this corrosion may be.

Another thing to consider in using different metals, too, is the electrical contact between them. When the metals are separated or insulated in some way, galvanic corrosion is checked.

And a third factor to keep in mind is the relative areas of the two metals. If they are in contact with each other, make sure that the parts having the smaller area are more noble than those having the larger area.

Oil field application

With these principles as guides, you can tell which metals are apt to produce strong galvanic corrosion on each other. And you can tell which are relatively safe to use in contact with each other. For example, "K" MONEL® sucker rods could be placed inside a carbon steel casing without causing galvanic corrosion.

Why? Because the fluid between tubing and casing would be virtually oxygen-free, and galvanic action would be cut off by the insulating effect of cathodic polarization. What's more, the area of the more noble "K" MONEL rods would be less than that of the casing.

Two good suggestions

1. Write for our free booklet, *Galvanic Corrosion in Oil and Gas Well Fluids.* It contains a thorough explanation of galvanic corrosion and discusses methods of preventing or appreciably reducing its effects.

2. If you have a metal problem, take it up with INCO's Technical Service. Available data from their Corrosion Files for a particular combination of metals will be furnished wherever possible. And Tech Service will be glad to help you apply general principles of galvanic corrosion control to your specific problems.

GALVANIC SERIES OF METALS AND ALLOYS

Corroded End
(anodic, or least noble)

▼

Magnesium
Magnesium alloys

▼

Zinc

▼

Aluminum 2S

▼

Cadmium

▼

Aluminum 17ST

▼

Steel or Iron
Cast Iron

▼

Chromium-iron (active)

▼

Ni-Resist

▼

18-8 Stainless (active)
18-8-3 Stainless (active)

▼

Lead-tin solders
Lead
Tin

▼

Nickel (active)
Inconel (active)

▼

Brasses
Copper
Bronzes
Copper-nickel alloys
Monel

▼

Silver solder

▼

Nickel (passive)
Inconel (passive)

▼

Chromium-iron (passive)
18-8 Stainless (passive)
18-8-3 Stainless (passive)

▼

Silver

▼

Graphite
Gold
Platinum

▼

Protected End
(cathodic, or most noble)

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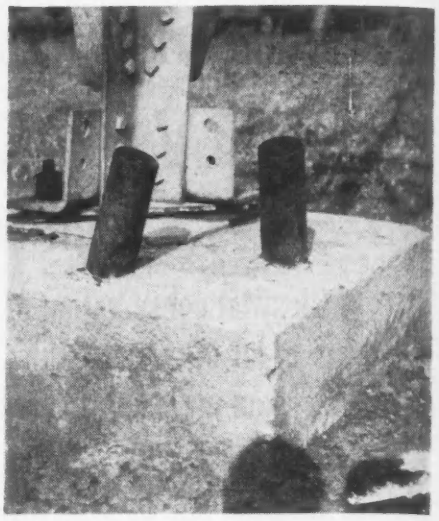
HOW TO—
Anchor Pulling Unit Winch Dead Line

Pulling units not equipped with telescoping masts can be set up at the well site in short order if adequate facilities are provided at the location. Such facilities usually include pulling unit hold-downs, truck wheel guides (or driveways) and a sturdy winch line anchor. Here is a simplified, time-saving method of anchoring the deadline on the pulling unit when setting up to work on a pumping well.

When setting up the production derrick, a little additional time was taken to insert into one of the derrick leg foundation forms a section of salvaged three-inch pipe shaped into a return bend. The pipe was bent smoothly in order to avoid any sharp projections in the pipe which would serve to injure or cut the anchored line. The bottom of the loop in the pipe extends to the very bottom of the concrete foundation and the upper ends extend 8 or 10 inches above the top of the concrete.

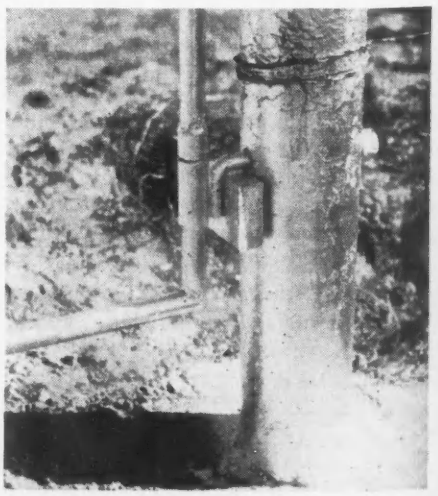


After the pulling unit is centered with respect to the well, the winch line is paid out and threaded through the crown and traveling blocks. The dead end of the line is then threaded through the bent pipe in the concrete foundation, and securely fastened with wire rope clips.

HOW TO—
Make Simple Gate Hinge Mounting

An unusually simple method of mounting a gate hinge, one which requires a minimum of materials and welding, yet is easy to install in the field, is illustrated. Principal feature of the mounting is the use of a block of wood against which the L-shaped bolt can be pulled to effect a solid mounting. The block provides a medium into which the bolt can "bite" as the nut is cinched up tightly. The gate is supported by and turns on the small sleeve to which the short arm of the L-shaped bolt is welded.

Should future adjustments be necessary, it is a simple matter to insert a new block.



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THE SMALL PRINT

TO REALLY SEE

WHAT'S IN A GUARANTEE?

Let's Examine An Average Guarantee

Most guarantees sound about alike. Although the wording may be slightly different, they usually have about the same meaning and give the same protection. The average warranty or guarantee is fine, as far as it goes. But how much protection does it really give the buyer? Let's analyze the "fine print" in an average factory warranty and see! First, the average warranty or guarantee simply sets forth that the equipment is guaranteed in event of defective materials or workmanship. The warranty is not a guarantee to the buyer that the equipment he has bought will do *his* job. Second, the average warranty is for a specific period of time. What happens to the equipment after that period is the sole responsibility of the owner. Third, the average warranty . . . in case of a failure that does come within the limits of the guarantee . . . does not cover normal wear in the period the equipment was used, or the cost of installing new equipment. So, after you boil it all down, the average warranty is chiefly a protection to the manufacturer and carefully limits in detail his responsibilities to the buyer only to the extent of defective materials or workmanship for a specific time. So in the final analysis, the average warranty does not fully protect the buyer. It is primarily a protection to the manufacturer.

Now, Let's Examine A Stewart & Stevenson Guarantee

When you buy an engine or any other product from Stewart & Stevenson Services, you are protected by *two* guarantees . . . the factory warranty against defective workmanship or materials *and* the unqualified Stewart & Stevenson "guarantee of duty." There is no fine print in the Stewart & Stevenson guarantee. We have made it as simple and straightforward as we know how. And here's what it means to the buyer. It means that Stewart & Stevenson Services guarantee your engine or equipment to do the job you bought it to do on your specific application—not just develop a certain amount of horsepower. That's right! The Stewart & Stevenson guarantee of duty specifies in plain and simple language what your engine is supposed to do on your particular job — to *your* specifications — and this Stewart & Stevenson guarantee is backed up with a provision that if your engine or equipment should fail and we cannot make it perform as specified when you bought it, we will remove the engine at our expense and refund *all* money paid.

Now, in plain language, what does a Stewart & Stevenson guarantee mean to the buyer? It means this: when you deal with Stewart & Stevenson Services, you have the protection of a guaranteed service policy—plus the manufacturer's warranty—and you know that there is no way in the world for you to buy equipment that won't do your job for the full specified period.

For more than fifty years, Stewart & Stevenson has been practicing this policy . . . a policy of a full measure guarantee and square dealing that has resulted in Stewart & Stevenson Services becoming the largest distributor of General Motors Diesel Engines in the Nation.

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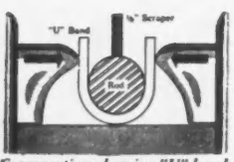
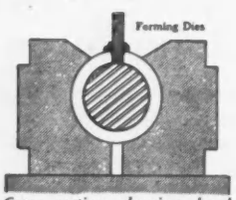
CRALL Spiral Paraffin Scrapers are designed to fit any sucker rod. They are sturdily constructed, but average only six ounces each in weight. Scores of major and independent oil-producing companies are now using CRALL Scrapers to their complete satisfaction.



Cross section showing "U" band being die-formed around rod to the scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade.

1. Scrapers alternate — one right one left — eliminating tendency of the rod to unscrew.
2. No work at well. Scrapers are attached at our factory, and stocked at supply stores.
3. No maintenance costs. Pay for themselves in saving down time.
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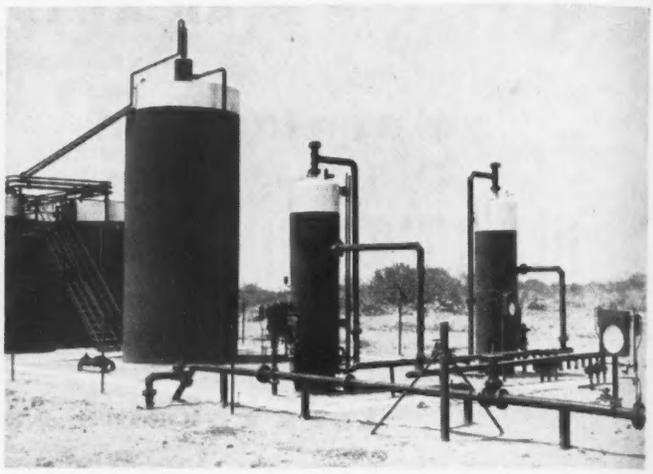
PRODUCTION HINTS

HOW TO—Improvise Field Blow Case



In fields where separators are operated at low pressure, the necessity of elevating the separators is eliminated by using one separator at the tank battery as a blow case. In the illustration the separator on the left has been thus converted. In the particular field where this method is used to boost the oil from the separator to the stock tanks, there is sufficient natural well pressure to move the oil to the separator, but the separator operates at too low a pressure to deliver the oil to stock.

The separator is connected to a high pressure field gas system. As oil enters the separator the pressure builds up to 15 pounds per square inch, at which point the dump valve opens and the high pressure gas is let into the separator blowing the oil over to the stock tanks. The blow gas is metered as it is used and is bled off into a low pressure field gas system along with the small amounts of the gas which entered the separator with the oil.

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Because of the protection provided, no well should be "put on the pump" without installing a Hercules Tubing Hanger for suspending the tubing. All Hercules Tubing Hangers use the well known Hercules overhead packing arrangement. Made in all sizes to support up to 4" tubing. There is also available a Hercules type RH Hanger with means for packing off around both cable and tubing when used with Reda bottom hole pumps. To assure complete tubing protection, be sure to specify Hercules Tubing Hangers. Write for Bulletin.

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T. E. WARD, President
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Developments in

Internal Pipe-Coating

By J. K. ALFRED
Assistant Area Superintendent
Shell Pipe Line Corporation, Colorado City, Texas

INTERNAL corrosion of pipe lines is a major problem in producing areas where oils with a high content of hydrogen sulfide are prevalent. Many previous papers have discussed the mechanism of such corrosion, as well as the frequency of resultant pipe line leaks and their staggering costs.

Other means of internal corrosion mitigation are in use, or have been tried, with various degrees of success. These include hydrogen-sulfide elimination by chemical additives, oxygen reduction by tank shutoff valves, brine and water elimination by gravity settling, increased stream velocity, and regular line-scraping programs. Developments of these types are still progressing, but the most reliable means developed to date are internal linings which prevent the oil and its entrained corrosives from coming in contact with the pipe walls.

A "hot spot" for internal corrosion is the Permian Basin of West Texas, and it thus is an ideal location for the development of preventive measures. Here three methods of combating such corrosion by lining the pipe with protective coatings have caused much local interest.

- Plastic lining applied in place.
- Cement lining applied in the mill or local plant.
- Cement lining applied in place.

All references are confined to crude oil pipe lines.

Plastic Coating in Place

The application of plastic on steel as a protective coating is not new in the oil industry. Most large companies have had some experience with plastic coatings on the inside of storage tanks or pressure vessels, or perhaps in pipe. Usually, however, the application has been made by brush, spray equipment, gravity flow, or dipping.

Late in 1947 a process was introduced in the Permian Basin for cleaning and coating the interior of a pipe line in place. It uses the Curtis-Tomlinson patent. The method involves the use of two double-opposed rubber plugs for the purpose of containing the cleaning medium or the plastic coating fluid in the pipe. These plugs are forced through the pipe line at controlled speeds by compressed air or inert gas; thus, the pipe walls are cleaned by friction or pressure, and they are coated by wiping action. The assembly is shown in Figure 1.

Each rubber plug comprises four truncated cones, two on each end, and joined in the center by a disc to make one unit. For any given pipe size, these plugs are made with their large diameters approximately one-eighth inch greater than standard inside diameter of the pipe. They are molded of first-grade neoprene, without internal reinforcement.

Other equipment required for the application includes:

- Two portable gasoline-engine-driven air compressors, capable of delivering approximately 110 cubic feet per minute at 120 pounds per square inch.

THE AUTHOR describes internal coatings now being used to protect pipe lines against internal corrosion by the West Texas Permian Basin sour crudes. He lists plastic linings, applied in place; cement lining applied in the mill or plant; cement lining applied in place. He also presents relative costs of and other economic data concerning these preventive measures. The paper is substantially as presented before the annual meeting of the API at Los Angeles.

- Sufficient lengths of pipe or hose to connect one compressor to each end of the section of pipe line to be coated.
- Two loading barrels of the same diameter as the pipe to be treated. One end of each of these has a reduced connection and a pressure-regulating valve to receive the air line, and the other is plain-end. These barrels also have a top connection with a combination loading-and-bleeding valve, and a pressure gauge.
- Two sleeve-type mechanical couplings capable of holding at 800-psi line pressure.
- Miscellaneous cleaning and brushing apparatus which will be described further in the sequence of an application.

A typical layout of this equipment, ready for operation, is shown in Figure 2.

Air piping is connected, and one of the plugs is placed in the upstream loading barrel. In the first stage of operation, various cleaning devices are then inserted into the barrel against the first plug. The second plug is placed in the pipe, and the barrel is coupled to the pipe line and connected to one of the compressors. At the other end of the line, the downstream loading barrel is connected, and air piping is completed to the second or downstream compressor. This downstream compressor is started first, and a pressure of 10 to 30 psi is built up. Then the upstream compressor is started, and the same pressure is obtained in the line—thus producing a condition of equilibrium. At the downstream barrel, pressure is reduced manually through the bleeder valve; this causes the two opposed plugs to move down the pipe line, carrying their contained load of either cleaning or coating material. The rate of travel of the two plugs is controlled by the amount of pressure reduction at the lower end. When the plugs and

their charge reach the downstream end, pressure is again equalized, and the direction of travel may be reversed in the cleaning operation by bleeding at the upstream end of the line.

One pipe line company has made a rather extensive use of this method to plastic-coat the interior of its lines in some of the most corrosive fields of the Permian Basin. This company reports the following steps as a typical application, the same being on a four inch medium - pressure oil - gathering line, 7400 feet long, which had been in service approximately four years:

1. The line was drained; then disconnected at both ends; and then turned over to the cleaning and coating contractor.

2. By the use of the loading and unloading barrels, one double-opposed plug was run through the line by compressed air to determine that it was clear and that oil pockets were emptied.

3. Another single plug, pushing circular wire brushes in front of it, was run as a preliminary cleaning operation.

4. Two plugs were then run with wire brushes, and with a cleaning solvent contained between them. This operation was reversed and repeated for a total of six trips.

5. Then a single plug, pushing large wads of toilet tissue, was run through. This was followed by another trip, pushing several gunny sacks. Runs pushing toilet tissue and gunny sacks were alternated seven times, with the gunny sacks wiping and the toilet tissue showing the degree of cleanliness.

6. Two plugs, with steel-lathe cuttings and shop-patterned scrapers contained between them, were passed slowly down the line. This process was reversed and repeated for a total of six trips, each taking approximately 30 minutes.

7. The line then was tested for leaks, with 120-psi air pressure.

8. More gunny sacks and toilet tissue were pushed alternately through for wiping and checking cleanliness. Six more trips were made.

9. Then a pretreatment of amine solution, contained between two plugs, was run to dispel moisture and to neutralize sulfur products—thus producing a paint-accepting surface.

10. A plastic prime coat was applied by containing the liquid between two plugs, with the compressor working, and with a pressure of approximately 30 psi at the upstream end. Time required was 30 minutes for the trip, during which 25 gallons of primer were used; 4.5 gallons of primer were pushed out ahead of the leading plug, through the bleeder connection at the downstream loading barrel, into a ready container. Ends of the pipe were opened, after which compressed air was blown through for six hours to dry the primer.

11. A plastic-finish coat then was applied in the same manner as the primer. The time required was again 30 minutes, during which 35 gallons of vinyl plastic were used. The line was again opened, and air was blown through for 12 hours to dry the final coat. This completed the application, after which the pipe line was reconnected back into service. The total time required for the job was two days.

Proven Method

Although this method of applying plastic coating to the inside of pipe lines is relatively new, the company mentioned has used it to apply various vinyl and polyester plastics of its own choice. Its first line was coated about 30 months ago, and since then it has used this method of application on 12 different sections of gathering and feeder lines, including 35,523 feet of 3-, 4-, 6-, and 12-inch pipe. With but one exception, all coating jobs have been performed on old pipe ranging from 1 to 12 years in prior service.

Before a contract job is accepted, at least one inspection section of each line is cut out and examined. Whenever feasible, these sections are reset in the line with mechanical couplings so that they may be removed and inspected at regular intervals. This provides useful data on the condition of the various coatings under different services, and it also gives an indication in the event the plastic begins to fail. In this 2½-year period only one of the 12 coated sections has failed. This occurred, and was detected, during the drying operation before the line was placed in service; therefore, it was cleaned out and recoated with a different type of plastic.

Gathering lines in the sour-crude districts served by this pipe line company have varying service lives, some being as short as eight months. It was not uncommon to have to raise and turn some lines 90 degrees after only one year's service. None of this company's lines, with plastic coated interiors applied by this process, has had a single inside corrosion leak to date.

Application of plastic coatings in place by this process vary in cost only slightly, depending on whether the pipe line is new or second-hand. Current quotations on average second-hand lines for cleaning and lining with one primer and one finish coat:

Pipe Size (Inches)	Cost Per Foot
3	$0.22
4	0.23
6	0.31
8	0.39
10	0.48

The prices include cleaning materials and customer's choice of plastics. Spot-welding, patching, and other repairs (if required) cost extra, and necessarily are done on a cost-plus basis.

To compare costs of this and other methods of internal lining, an actual four-inch gathering line 7400 feet long has been used as an example. Other prices per foot used in the costing are:

Application	Cost Per Foot
New pipe	$0.80
Lay new pipe	0.26
Take up old pipe	0.16
Sell old pipe as junk	0.15
Sell as second-hand usable	0.40

This 7400-foot line was actually lined with plastic in 1949. In the ten months prior to its coating, 21 leaks occurred from internal corrosion. This caused a loss of 740 barrels of oil. The cost of leak repairs, and of oil and damage losses, totaled $2898. Replacement of this line with new pipe, including takeup of the old, would have cost $9350. (No allowance is included for sale of old pipe.) To strip out, raise, and turn 180 degrees would have cost $2600. The cost to apply the plastic coating in place was $1698—which, based on savings from leak reduction, and assuming no increase in

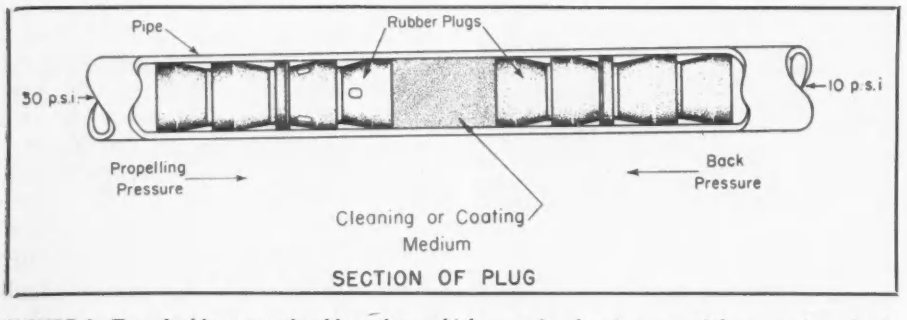


FIGURE 1. Two double-opposed rubber plugs which contain cleaning material or coating plastic within the pipe.

leak frequency, would indicate a payout of the expenditure in six months.

Advantages of this method of line protection:

- The pipe does not need to be removed and relaid.
- Outside protective coatings are not disturbed or damaged.
- Damages to rights-of-way are relatively small or negligible.
- The friction factor is improved, thus providing some increase in flow rate.

Disadvantages:

- The line must be taken out of service for varying lengths of time, depending on the interior condition of the pipe. It probably would not be applicable on long feeder lines without the use and added cost of a temporary bypass line.
- A complete coating job cannot be assured in spite of frequent removal of inspection sections.
- If compressed air is used as a driving medium, the hazard of explosion is prevalent.
- Damage to coating may be caused later by use of plug-type scrapers.

Cement Lining Applied

Pipe with interior cement lining has been used in water lines for more than 100 years. However, in the oil industry, this span of use is hardly more than 20 years, with service principally in salt water disposal systems and in refinery flow lines which carry highly corrosive mixtures. Relatively few crude oil gathering or feeder lines were built of cement-lined pipe prior to 1940.

Several manufacturers during the total period have produced steel or cast-iron pipe with cement linings. At least two of the larger tube mills are now marketing pipe which has such an internal coating of cement. Its use, however, requires purchase of new pipe from the mill.

In the past plants have been built to apply cement linings locally in areas of corrosive waters or oils. In the Permian Basin such a plant was erected in early 1948. It is at Odessa, Texas, which is central to the extremely "sour-crude" districts. This plant does not sell pipe; but it furnishes labor and materials, and coats any pipe which its customers send to the plant.

Because the lining may be applied to used as well as to new pipe, an internal cleaning service is also offered by the plant. On used pipe, cleaning is accomplished by butane flame torches with extension handles, so that the hydrocarbon products are burned and scale is loosened. Pneumatic tubing rattlers knock the loosened scale from the pipe walls, and this scale is removed from the pipe walls by alternately swabbing and washing with water. An inspection follows, after which holes are patched or spot-welded. A hydrostatic-pressure test may be applied if desired by the customer.

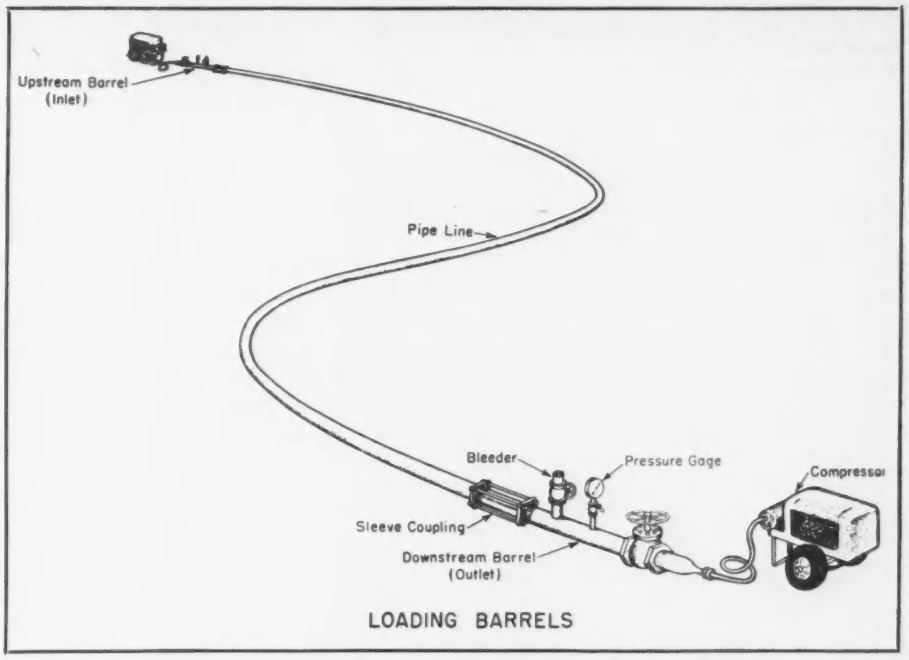


FIGURE 2. A typical layout of equipment for plastic coating in place, assembled and ready to operate.

The materials used for the lining are essentially a mixture of first-grade hydraulic cement, limestone slag, and native West Texas blow sand. These are heated separately for drying, and then are ground together in ball mills to a fineness which will pass a 70-mesh screen.

The materials are wet for mixing in batches, each batch sufficient to line one joint of pipe. The hopper of a mixing machine is loaded with the dry materials. Then—depending on the length, inside diameter, and condition of the pipe (new or used)—a predetermined volume by weight is charged to the mixer. As an example, each linear foot of standard four-inch new pipe takes 2¼ pounds of dry material; whereas identical used pipe takes 2½ pounds.

Each joint of pipe is loaded separately with the wet mixture, which contains sufficient water to allow gravity flow. The joint is capped on each end, and is hydraulically lifted onto the rolls of a spinning machine where, with the aid of holddown idlers, it is spun at the rate of 950 surface feet per minute for 1¼ minutes. In this operation, centrifugal force causes the solids of the mixture to take a uniform shape as a smooth, but dense, lining on the interior walls of the pipe. Joints up to 41 feet long can be handled in this manner. After the joint has been uncapped and drained, the interior is inspected with mirrors, and each end is hand-finished. A bell-end tool produces square edges even with the ends of the pipe.

Joints are then loaded on cars and transferred to curing kilns, where they are subjected to a 200° F. steam treatment for eight hours. The high humidity in this operation retards shrinkage and prevents cracking of the lining. Following this, the lined pipe is allowed to cure at least 24 hours in atmosphere, after which it is ready for service.

The lining thickness thus produced varies only slightly, and is nominally 3/16 inch on 2-, 3-, or 4-inch pipe or one-fourth inch on 6-, 8-, and 10-inch pipe. Being a continuous arch confined to the pipe walls, the lining is self-supporting; therefore, no special handling of the pipe is required other than ordinary diligence in loading and unloading—particularly the avoidance of the use of hooks in the ends of the joints.

Several pipe line companies are now having pipe from their own stocks coated in this local plant, in the specific sizes and amounts required to fit various jobs, large or small. Plain-end as well as thread-and-coupled pipe is processed as requested.

In laying thread-and-coupled pipe, an overlapping plastic sleeve and a sealing compound are generally used. Plain-end pipe, beveled for welding, is joined in several ways. One company uses a one-eighth-inch asbestos gasket, precut to fit the inside diam-

eter of the lined pipe and the lip of the beveled end. Just prior to line-up of the pipe, the gasket is set in place with undiluted sodium silicate (water glass) applied to both faces of the material. During the welding operation the transfer of heat is minimized, and the sodium silicate forms a corrosion-resistant glazed surface on the interior walls. Welds cut from cement-lined pipe joined in this way indicate well sealed interior joints, and no damage to the lining. Another company tightly butts the joints together, without standard spacing, and it runs the stringer bead in, using a one-eighth-inch or smaller rod. This company also has cut test welds for examination, and it reports no damage to the lining.

Field bends of such cement-lined pipe are restricted to ten degrees in 20 feet. Sharper curvature requires the use of fabricated bends, which can also be obtained with cement linings applied by hand methods. From current experience, contract costs of laying cement-lined pipe are seldom more than 5 percent additional to the cost of laying unlined pipe.

In a small trunk line, one company has installed 120,000 feet of such cement-lined pipe, ranging in size from 6⅝ to 8⅝ inch in outside diameter. This line serves one of the sourest crude fields of the Permian Basin, and operates at pressures up to 950 pounds per square inch. The line was originally laid of plain steel pipe in 1937. Cement-lined pipe has been laid as a replacement in five increments since 1942—some in sections which had been replaced one or more times previously with plain steel pipe. Only the first increments were laid with pipe which had the lining in place when purchased from the mill. Prior to the laying of the cement-lined pipe, a total of 788 leaks occurred in these five sections. No leaks have developed to date in the cement-lined pipe, some of which has been in service as long as eight years.

This same pipe line company has installed 35,900 feet of such cement-lined pipe as replacements for 4-, 6-, and 10-inch steel pipe in gathering systems. Service of the cement-lined sections varies from eight months to 7½ years; and, although 455 leaks were experienced in the plain steel pipe, none has developed in the cement-lined replacement sections. Another pipe line company in this area has installed 121,000 feet of cement-lined pipe in its gathering systems, with excellent results in eliminating internal corrosion problems.

The fact that any amount of either new or secondhand pipe can now be cement-lined locally in the Permian Basin has increased the use of this means of controlling internal corrosion of pipe lines. Quotations for this lining service at the plant in Odessa are:

Pipe Size (Inches)	Cost Per Foot
2	$0.20
3	0.25
4	0.35
6	0.60
8	0.70

(Jobs more than 10,000 feet in length receive a 10 percent discount. If the pipe is second-hand, patching and repairs are done on a force-account basis.)

Consider again the 7400-foot section of four-inch gathering line, cited under "plastic coating," which had a cost of $2898 for oil loss, damage, and repairs within ten months. Cement lining, at the local plant, of pipe equally as good as that to be removed would cost $2590, and laying costs would amount to $1990. If the expense of taking up and cleaning the old line and turning it to stock in place of the newly lined pipe is added, the cost is $5910 for replacing the plain steel with cement-lined pipe. Again assuming no increase in leak frequency, the savings in "leak expense eliminated" would pay out the cost of cement-lined pipe in 20 months. This figure applies regardless of whether the original pipe is cleaned and coated at the plant and then relaid, or whether other second-hand pipe is coated and laid after which the original pipe is cleaned and returned to second-hand stock. Of course, the latter is the only means by which an extended service interruption can be avoided.

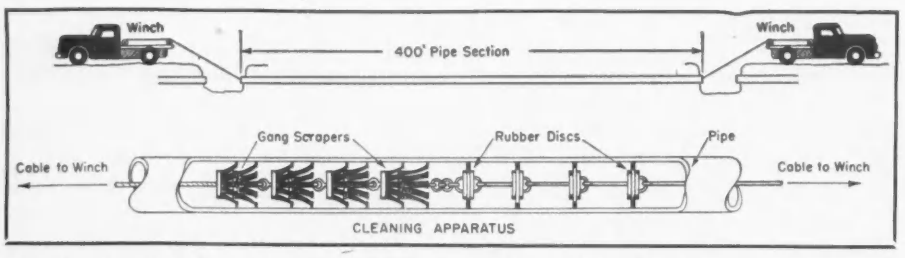


FIGURE 3. Wiping discs and scrapers attached to "pull cable" for cleaning interior of pipe line prior to cement-lining in place.

Advantages of plant-coat cement-lined pipe:

1. By visual inspection, assurance is given that the coating is complete.
2. There is little doubt that the life of the coated line will be five to eight years or longer.
3. No chance exists for fire or explosion as compared to other internal coatings.
4. There is no limitation to operating pressures other than the standards for the particular quality and thickness of pipe which bears the internal coating.
5. No appreciable losses result from operational downtime while cement coating is applied.

Disadvantages:

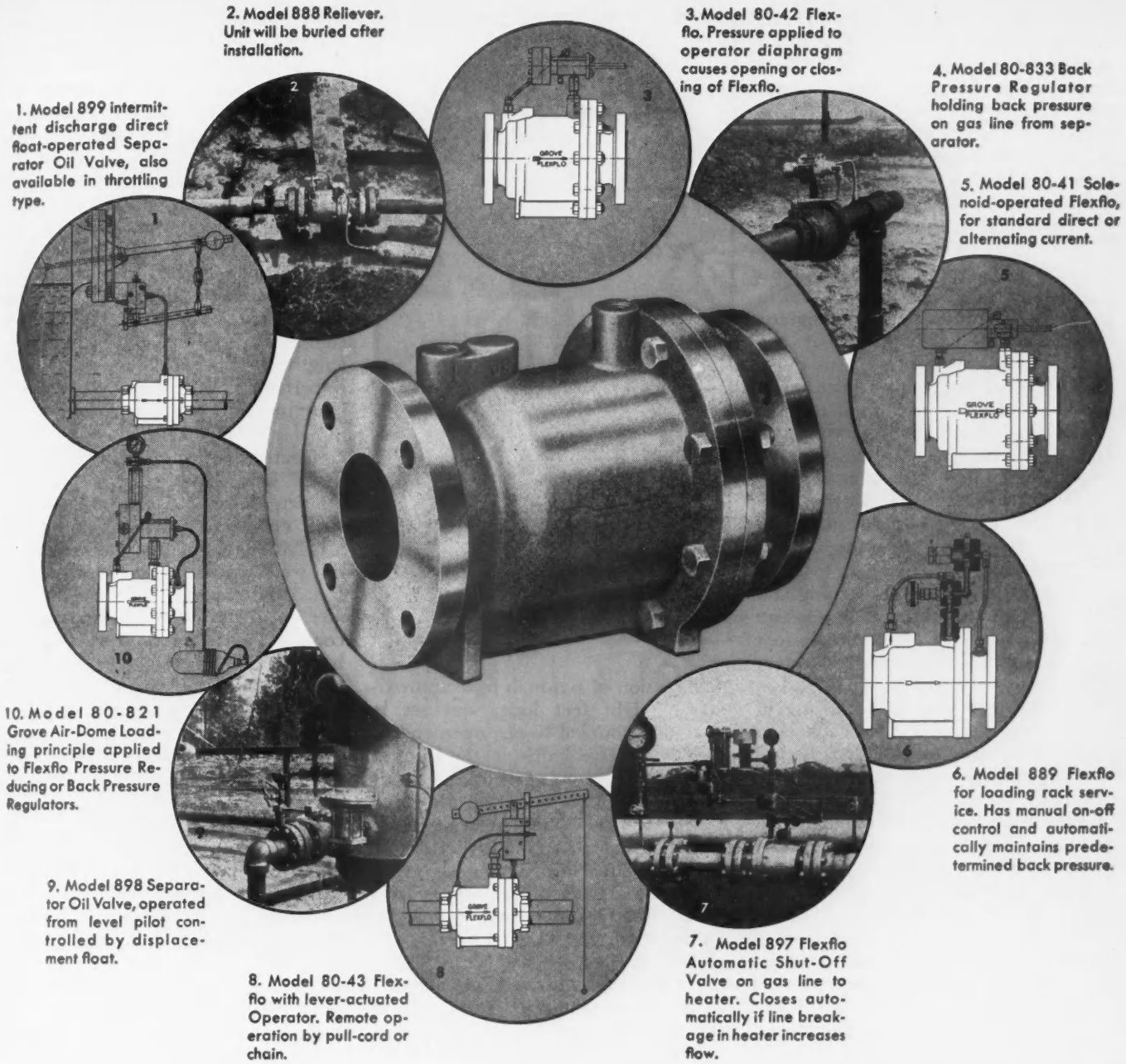
1. Construction damages will accrue because of laying and taking up of pipe.
2. Previous external coatings are destroyed.
3. Slightly higher laying costs are involved.
4. Salvage of welded lines which have a cement lining would require higher takeup cost and would result in appreciable loss of inside coating.
5. Additional cost of fittings is required in place of ordinary field bends.
6. Reduction in effective inside diameter might be so critical as to require the use of the next larger size of pipe.

Cement Lining in Place

Pipe has been internally coated in place with cement for 30 years or longer. This process has its inception on municipal water lines, where the cost of replacement or reconditioning of large mains or service laterals was almost prohibitive because of the location of buildings or other permanent structures. Its application to oil pipe lines is quite new. The process is covered by an Australian patent, and an oil tanker-unloading line is reported to have been concrete-lined in the port of Sidney.

Basically, the process consists of applying a relatively dry cement-sand mortar to the interior walls of the pipe. This is done by using a bullet-shaped mandrel with its large diameter of such size that the shape of the lining will conform to the thickness requested by the customer. This application is made on short sections of the line, approximately 400 feet in length, with the mandrel drawn through the sections by cables attached to truck winches. Interior cleaning, prior to the placing of the lining, is accomplished by cable-drawn rubber discs and steel scrapers.

The 24-mile length of crude oil line



1. Model 899 intermittent discharge direct float-operated Separator Oil Valve, also available in throttling type.

2. Model 888 Reliever. Unit will be buried after installation.

3. Model 80-42 Flexflo. Pressure applied to operator diaphragm causes opening or closing of Flexflo.

4. Model 80-833 Back Pressure Regulator holding back pressure on gas line from separator.

5. Model 80-41 Solenoid-operated Flexflo, for standard direct or alternating current.

6. Model 889 Flexflo for loading rack service. Has manual on-off control and automatically maintains predetermined back pressure.

7. Model 897 Flexflo Automatic Shut-Off Valve on gas line to heater. Closes automatically if line breakage in heater increases flow.

8. Model 80-43 Flexflo with lever-actuated Operator. Remote operation by pull-cord or chain.

9. Model 898 Separator Oil Valve, operated from level pilot controlled by displacement float.

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which was coated in place in this manner during mid-1949 is a 10¾-inch main gravity-feeder in Lea County, New Mexico. Both new and second-hand pipe of three different wall thicknesses are included in this electric-welded line, laid originally in 1940.

Inasmuch as it was estimated that 90 days would be required to coat the line in place, a two-mile temporary loop of eight-inch line was laid on top of the ground. This was placed in service to free the ten-inch line for contractor's work. Throughout the entire job it was necessary to move this eight-inch bypass two miles ahead and tie it into service; then to take the ten-inch line out of service long enough to drain it, tie in the two-mile coated section from the rear, and reconnect the loop ahead. As the work progressed, each two-mile section of ten-inch line was cut into 400-foot lengths for a "pull."

A typical operation of cleaning and lining one of these lengths was begun by excavating; then cutting a six-foot piece from each of the ends. A three-fourths-inch cable was threaded through the section with the use of oil-well sucker rods. This cable was attached to several rubber squeegee discs, which were slightly oversize to the inside diameter of the pipe, and to spring-steel gang scrapers. This apparatus (Figure 3) was repeatedly pulled through the pipe line by a truck winch until neither fluid nor scale was discharged.

The lining material, composed of washed sand and common portland cement, was mixed by hand in an ordinary mortar box. The sand was of two grades (fineness not disclosed), and was shipped in from the Pacific Coast in paper bags—thus making it more costly than the cement. Only sufficient water was used to make the mix fluid. No slump tests were taken.

A long-radius elbow, fixed to a vertical section of ten-inch pipe approximately eight feet long, was set in place and coupled to one open end of the line. A free baffle in the form of a rubber disc, oversize to the inside diameter of the pipe, was threaded loosely on the "pull cable." Mortar was then loaded through the "gooseneck" into the line. This is shown in Figure 4. The weight of the mix packed the mortar tightly against the baffle. With the lining charge completed, the "gooseneck" was dropped from the end of the pipe and the mandrel was connected to the end of the cable (Figure 4).

This projectile-shaped mandrel, approximately 30 inches long, was tapered, with guides for centering it within the pipe. The rear 12 inches were cylindrically shaped of a diameter to form a 5/16-inch-thick cement coating on the pipe walls. This section was perforated; thus the water in the mortar was pressed out and allowed to settle in the bottom of the line. No means of water removal was provided; thus a cement laitance approximately ⅝ inch thick was formed in the bottom of the pipe.

A truck winch pulled the charge and the coating devices down the line at the rate of about 20 feet per minute. The loose baffle forced the mortar against the mandrel, which lined the pipe to the desired thickness. Upon completion of the pull, the entire length was inspected by mirrors for imperfections; then capped for a 48-hour minimum curing period.

Each of the 400-foot sections was connected by welding in a prelined "pup" joint. Hand holes six inches in diameter were left open in the top of each end of these short joints and, after welding, the interior area around the weld was hand-coated with mortar. A patch plate, 12 inches in diameter, with its underside treated with coal tar, was then welded over each hole.

This was the operation progressively followed throughout the entire cement-lining job. Work was started in May, 1949, and completed the following August. Because of difficulties encountered, progress varied considerably, but it averaged 2000 feet per day. Random test sections were cut from the line by the owner. All were satisfactory with respect to cement coverage and uniformity of the thickness, as well as to smoothness of the surface.

Although many corrosion holes were apparent in the line after it had been cleaned, others were purposely made to test the action of the lining under this condition. The result was complete penetration of the holes by the mortar and sealing of the holes satisfactorily for gravity flow-line pressures. Prior to this coating job, oil leaks were numerous in the bottom half of this line. A series of inside-diameter measurements taken during the progress of the work indicated metal losses up to 75 percent of the original pipe-wall thickness, and not uniformly in the bottom quadrant. After one year in operation, no leaks have been experienced.

Current quoted prices on cement lining of oil pipe lines in place, including cleaning:

Pipe Size (Inches)	Cost Per Foot
4	$0.82
6	1.06
10	1.50

If a bypass line is required, this

■ CONTINUED ON PAGE 190

About the Author

J. K. ALFRED, a graduate of Oklahoma University with a B. S. in civil engineering in 1934, has been with Shell Pipe Line Corporation since 1935, as engineer trainee, engineer, area engineer and his present position of assistant area superintendent for the West Texas area, with headquarters at Colorado City, Texas. He is a registered professional engineer.

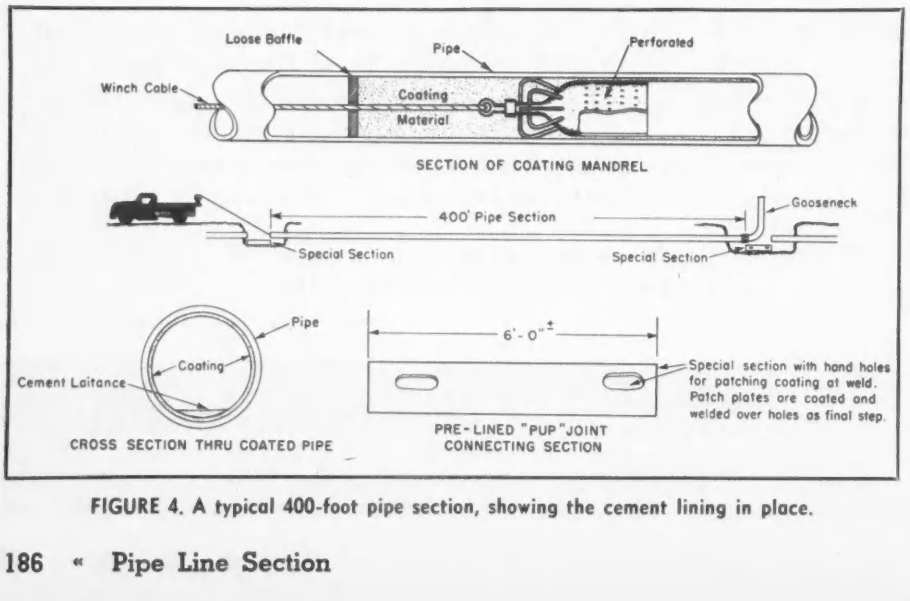

FIGURE 4. A typical 400-foot pipe section, showing the cement lining in place.

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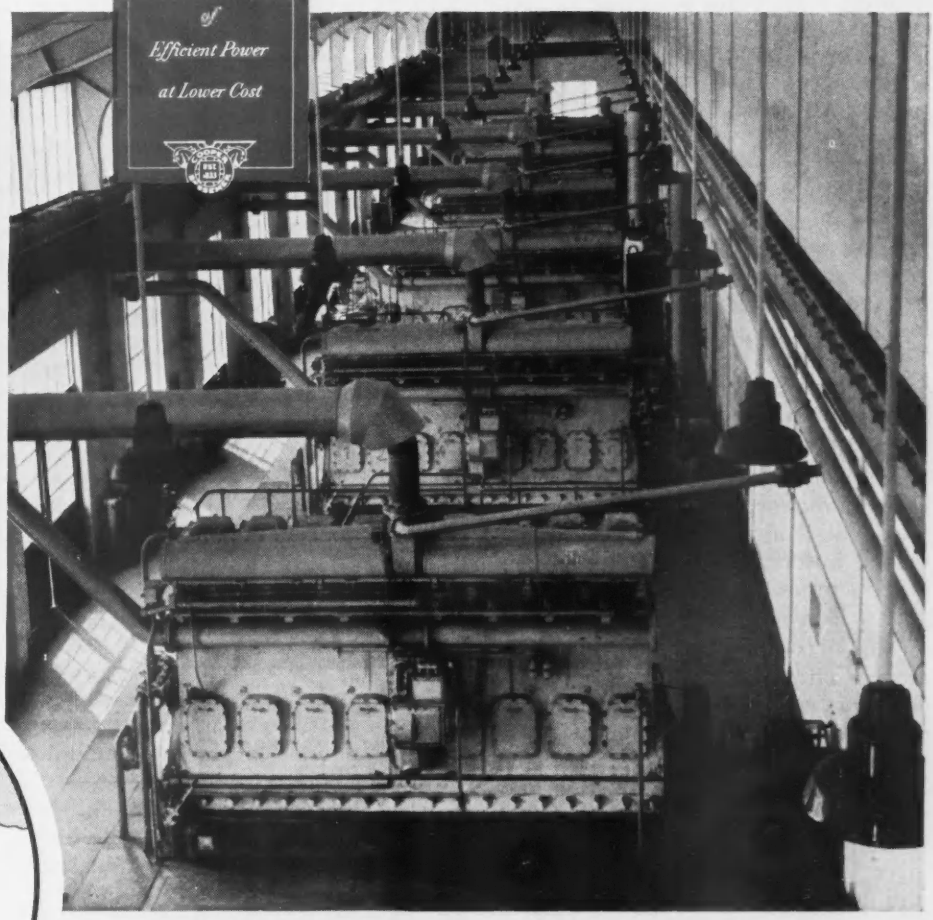

Cooper-Bessemer LS-8 engines in Creole Petroleum Corporation's Ulé pumping station. Engines, direct-connected through a fire-wall to 8" x 24" triplex pumps, are rated 1000 bhp at 300 rpm. Rated capacity of each pumping unit is 50,000 bbl a day.

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Design of *Unattended* Booster Station

By J. P. HEDLIN
Engineer, Products Pipe Line Department,
Standard Oil Company (Indiana)

ECONOMICS OF an unattended pipe line station may be such as to make an installation necessary if the line is to remain competitive. This paper was presented before an API pipe line symposium in St. Louis last summer.

STANDARD Oil Company (Indiana), one of the principal stockholders of Wyco Pipe Line Company, has recently supervised the construction of an unattended automatic booster station on Wyco's products pipe line from Casper to Denver.

This accomplishment is in itself a pioneer effort for the firm's pipe line engineers and may be a first in the industry. Because this station has been in operation only a short time, since July, 1950, no over-all operating and maintenance experience is available to date; however, the station was given a rigorous series of trial runs and it functioned as designed.

The author has reason to believe that the pipe line industry in general is more than mildly interested in unattended automatic booster stations. In these times of rising operating costs, it is becoming necessary for the industry, in general, to provide more service at less cost to maintain its competitive position; hence the entrance of the unattended automatic pumping station. This type of station has an economic advantage over its predecessor (the attended station). However, the question of economy through the use of unattended automatic stations should be examined for each individual case.

In the case of this small station of only 250 horsepower, it was found that the total cost of the station as built was no greater and possibly less than the cost of a similar attended station. These savings were realized because of economies in the building, the heating plant and the foundations which offset the added expenditures for the necessary automatic equipment. In the design of this station, the sole purpose of the building is to protect the operating equipment from the weather. This design principle precludes, therefore, the necessary facilities that are required at an attended station. The result is a simple prefabricated steel structure.

Since the station is unattended, the heating plant, the water well and other facilities that are required at a station where personnel is required on duty have been eliminated. This also has effected a savings. Because of the type pump used, which will be explained later, an appreciable savings was also effected in the foundations. This station also has the advantage over a conventional type of station of realizing a savings of approximately $20,000 to $25,000 per year in operating labor. As a result of these facts it is evident that in this case the unattended automatic station had marked advantage over a fully manned station.

The primary considerations in the design of an unattended automatic booster station are the pumping equipment and the controlling devices. The basic requirement of the pumps is that they can be operated without danger of an external product leak in the event of a gland (or seal) failure. The pump that meets this requirement is the stuffing-boxless type. Since the motor and pump are completely enclosed in a pressure-tight bolted case, the stuffing box and packing have been eliminated. This does away with the principal cause for operational attendance and maintenance.

One of the salient features in this type pump is the mechanical seal between the motor and the pump. The motor, including its bearings, operates completely submerged in an enclosed pressure chamber filled with transformer oil which is used for the dual purpose of insulation and lubrication. Leakage across the mechanical seal is so regulated that it occurs only from the motor side to the pump side, preventing any product from leaking into the motor casing. This is accomplished by keeping the transformer oil at a higher pressure than the product suction pressure at all times when the pump is in operation. While the unit is shut down, the pressures in the pump case and the motor case are equal, and under these conditions, the spring tension on the mechanical seal prevents leaking from the pump side to the motor side. To protect the pumps, a pump diaphragm switch is installed in each pump to automatically shut down the unit when the reserve supply of motor insulating and cooling oil approaches depletion.

To date, these units have been manufactured in only the 125-hp size, which has obviously limited the size of fully automatic stations. One pump manufacturer has indicated a willingness to manufacture this type of pump up to and including the 400-hp size. The reluctance of manufacturers to produce this pump in large sizes was based on the difficulty of cooling the motor.

The unattended automatic booster station constructed is a two-unit, 250-hp station capable of pumping 18,500 barrels per day of 0.73 specific gravity gasoline at a pressure of 215 pounds per square inch per unit or a total of 430 psi for both units. The station was named Bear Creek. Its location can be seen in Figure 1. This station incorporates a control system for complete automatic operation of the pumps in accordance with the setting of a master control switch which can be set for either one unit, two units, or no units operating depending upon the desired line throughput. It is es-

sentially a pressure controlled station and will pump as long as the upstream station supplies sufficient pressure.

In Figure 2 is shown the profile for the Wyco Line. Normally the profile would not assume any great importance in the operation of a pumping station; however, in the case of Bear Creek Station, the profile cannot be overlooked. It will be noted from an examination of the profile that the static head on Bear Creek Station is 500 psi (gasoline). Since one unit of this station can develop a shutdown head of only 315 psi (gasoline), which in itself is not sufficient to overcome the static head, it is readily apparent that some provision must be made to prevent the pumps from spinning and as a result overheating. This problem was solved by installing a mercury pressure switch on the discharge side of the station. This pressure switch is set to open at 530 psi and close at 700 psi. This means that when the discharge pressure with the station operating drops to 530 psi, the switch will open and shut down the station. The station will remain inoperative until the pressure as supplied by the upstream station rises to 700 psi at which time the switch will close and place the station in operation.

Figure 3 shows a diagrammatic view of the station piping. It will be noted from an inspection of the piping arrangement that the pumps have been installed in such a manner that when not in operation, flow is directed through the pump sump and the check valve bypass. The divider gates are in the main line which necessitates shutting down the station, opening these gate valves whenever scrapers are run; however, runs are so infrequent that this procedure imposes no serious problem. The strainer shown is only a coarse mesh of four openings per inch.

It will be noted from Figure 3 that two mercury switches are installed on the discharge side of the station. The control mercury switch as previously explained prevents the discharge pressure from falling below hill pressure with one unit operating. The one labeled "high pressure switch" is installed to shut down the station when the discharge pressure exceeds the maximum allowable operating line pressure; namely, 1200 psi. This switch is set to trip at 1220 psi. The low pressure switch on the suction side of the station is set to open at 200 psi and close at 700 psi. When two units are operating and the upstream station is shut down, the suction mercury switch will open to shut down Bear Creek Station. When one unit is operating and the upstream station is shut down, the minimum discharge pressure is reached before the suction pressure reaches its minimum, therefore, the control switch stops the station. Reset of the low pressure and control switches is set at 700 psi. This means that the upstream station will have to supply 200 psi more than the static condition to put Bear Creek Station on the line. All three of these controls are electrically connected in series which requires all of them to be in a closed position for the station to operate.

When the station is set for operation and sufficient pressure is present to close the control switch and the low pressure mercury switch, the first unit will start. Simultaneously with the starting of the pump, the motor operated discharge valve begins to open. The motor operated discharge valve takes 45 seconds to reach the full open position and as it approaches its full open position, the bypass check valve is closed due to the differential pressure created by the pump. A safety feature is a delay timer which will shut down the unit if the motor operated valve does not reach its full open position in one minute and 15 seconds. This device was designed to prevent the pump from running against a closed valve which might happen if the motor operated valve failed to open. When a unit stops, the control wiring is so arranged that the motor operated valves will close. However, in the event of a power failure, the motor operated valve will remain open until power is restored. If this condition develops; namely, power failure at the station, the discharge valve remains open, flow then is automatically directed through the pump sump and check valve as previously shown in Figure 3.

As an added safety feature, each unit has an incomplete sequence relay installed in its control wiring. This relay prevents the pump from attempting to start again if it failed to complete its starting cycle for any reason. For instance, if the motor-operated valve failed to reach its full open position in 1¼ minutes, the unit would stop and the valve would close. The incomplete sequence relay would prevent the unit from attempting to start again until manually reset.

Each pump unit has under-voltage time delay relays that will prevent

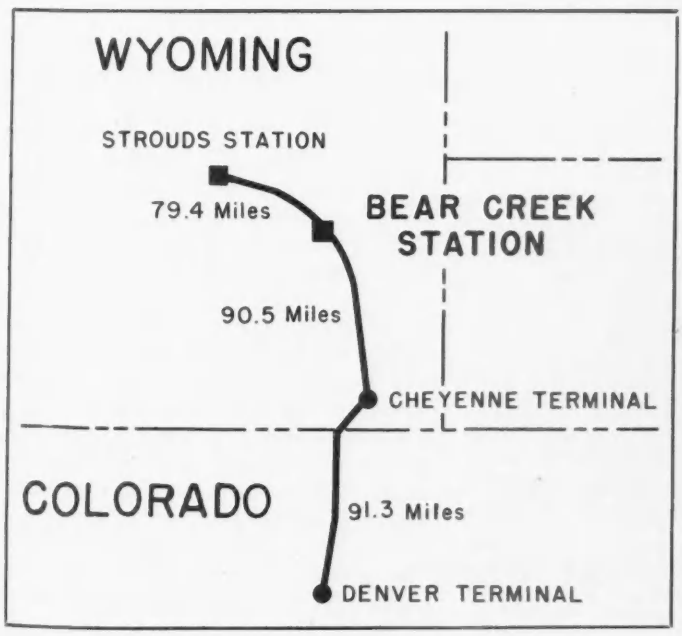


FIGURE 1

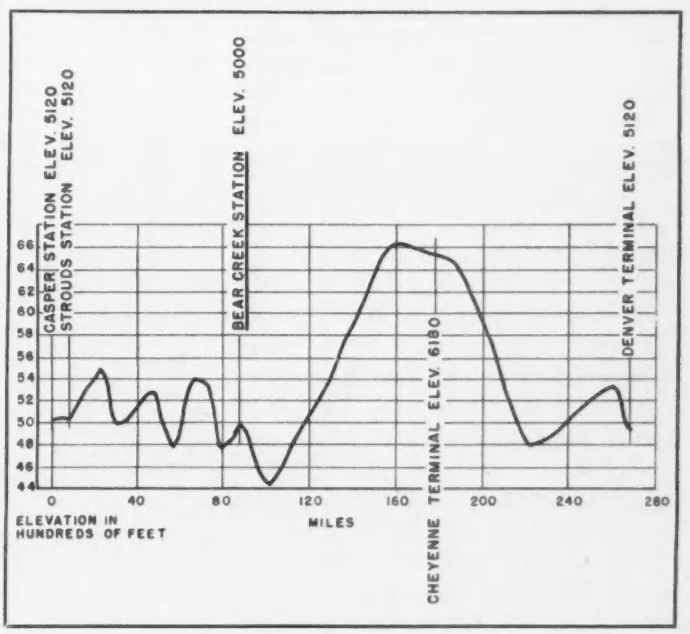


FIGURE 2. Profile, Wyco pipe line.

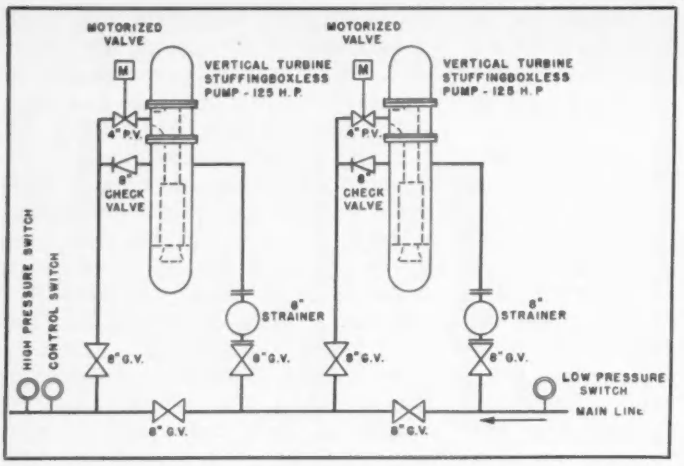


FIGURE 3. Flow diagram, Bear Creek Station.

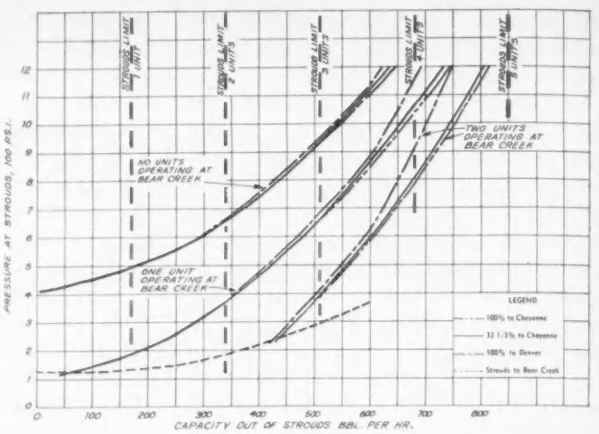

PRESSURE AT STROUDS, 100 P.S.I.
CAPACITY OUT OF STROUDS BBL. PER HR.
STROUDS LIMIT 1 UNITS
STROUDS LIMIT 2 UNITS
STROUDS LIMIT 3 UNITS
STROUDS LIMIT 4 UNITS
STROUDS LIMIT 5 UNITS
NO UNITS OPERATING AT BEAR CREEK
ONE UNIT OPERATING AT BEAR CREEK
TWO UNITS OPERATING AT BEAR CREEK
LEGEND
100% to Cheyenne
33 1/3% to Cheyenne
100% to Denver
Strouds to Bear Creek

FIGURE 4. Wyco capacity curve, Strouds to Cheyenne and Denver.

the unit from being shut down due to momentary voltage dips. This relay will trip two seconds after voltage failure. A voltage dip will cause the motor starter to drop out and stop the motor, but if voltage is restored within two seconds, it will start again without going through a complete shutdown and starting sequence.

If the second pump is to be used it will start ten minutes after the first pump and in the same sequence. This delay between the starting of units allows the first unit ample time to load up and accelerate the stream. The pumps are started across the line with 440-volt oil immersed combination starters with solenoid operated contactors. Each motor feed circuit is connected to an open and reverse phase relay which trips when the power supply reverses phase or has one of its phases open. The action of either relay will shut down both units.

To assist the operating personnel, a series of graphs similar to the one shown in Figure 4 which is for gasoline, were constructed. These graphs relate the discharge pressure at the origin station (Strouds) to the volume pumped by the station. Referring to Figure 4, it will be noted that three groups of curves each containing three curves were plotted. The three groups are no units operating at Bear Creek, one unit operating at Bear Creek, and two units operating at Bear Creek. The three curves in each group represent the two extremes and the average for the terminal receipts.

The value of this curve to the operator lies in the fact that for any given pumping rate, number of units operating at Bear Creek, and terminal delivery, he can quickly determine his discharge pressure at the origin station. From the dispatcher's point of view, these graphs are invaluable in that for any required pumping rate and terminal delivery, he can predetermine and preset the number of units to be operated at Bear Creek during any month for a given tender of products.

Although this paper has been prepared without the benefit of an extended period of station operation, the design has served a definite purpose in providing additional capacity at a remote location and to date has proven entirely satisfactory. This installation may well be the prototype for similar improved pumping stations that will operate without personnel on duty.

The significance of this step cannot be ignored in view of increasing operating costs.

Developments in Internal Pipe-Coating

■ CONTINUED FROM PAGE 186

must be provided at the customer's expense.

For comparison, the example used under plastic coatings in place is taken again to indicate profitability. This four-inch gravity line, 7400 feet in length, cost $2898 for oil loss and for leak repair during ten months. The cost of cement-lining it in place would have been $6068, which would appear to pay out in 21 months because of savings in leak costs. These figures are based on the assumption that no bypass line would be required for an approximate four-day shutdown of the line.

Advantages of cement-lining pipe in place:

1. The line does not require taking up and relaying.

2. Exterior protective coatings are not damaged, because the line is not disturbed.

3. Damage to property owners is relatively small.

Disadvantages:

1. Assurance cannot be obtained that the pipe has been coated without imperfections.

2. Line operations would be limited to minimum pressures because of mortar-filled holes.

3. Downtime and coating costs would be increased in rough or uneven terrain.

4. Reduction of internal area of the pipe, including cement-laitance deposit, might be so critical as to eliminate this method.

5. Amount of downtime required might also be critical enough to eliminate this process.

Summary

In summary, it is the general opinion of those pipe line operators who were contacted in the preparation of this report that, in the most corrosive fields, any interior coatings which will last two years or longer are profitable on gathering and feeder lines. Further, they agree that it is more economical to utilize available coatings for these locations than to await development of other processes which may eliminate internal corrosion in pipe lines. With the prospect ahead of another period of shortage of tubular goods, much line pipe can be reused over and over again by the application of inside coating of the owner's choice.

ACKNOWLEDGMENT

Appreciation is expressed to the following groups which furnished the information for the paper: Humble Pipe Line Company, The Texas-New Mexico Pipe Line Company, Permian Enterprises, Inc., Curtis Tomlinson Company and Shell Pipe Line Corporation.

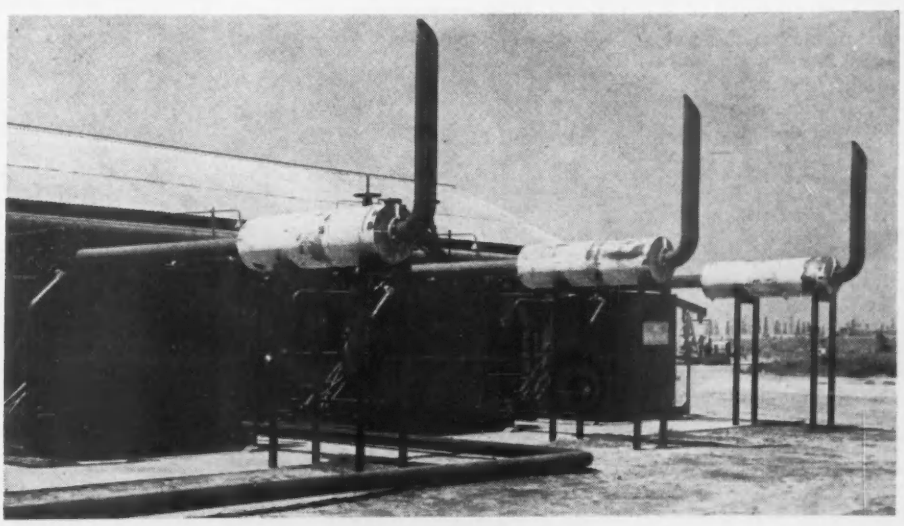
Individual Drive Cooling Units

ON A BOOSTER station to handle production gas in a Southern California oil field, the engineering department planned to eliminate as much auxiliary power as practicable so that maintenance costs would remain low, and so that the station would be almost automatic in operation. The unit included a novel radiator fan drive. Three 6-cylinder, 11x12-inch V-type engines with horizontal compressor cylinders, 23-inch bore and 12-inch stroke, are operated at 350 revolutions per minute to take suction at 8-inch mercury vacuum, and discharge at 7 pounds per square inch gauge into the system leading to the main compressor station. They are built with conventional water jackets and arranged for any type of cooling; enclosed coil, radiator or spray pond cooling. Due to conditions in the field, it was decided to equip each unit with an individual large capacity outside installed radiator.

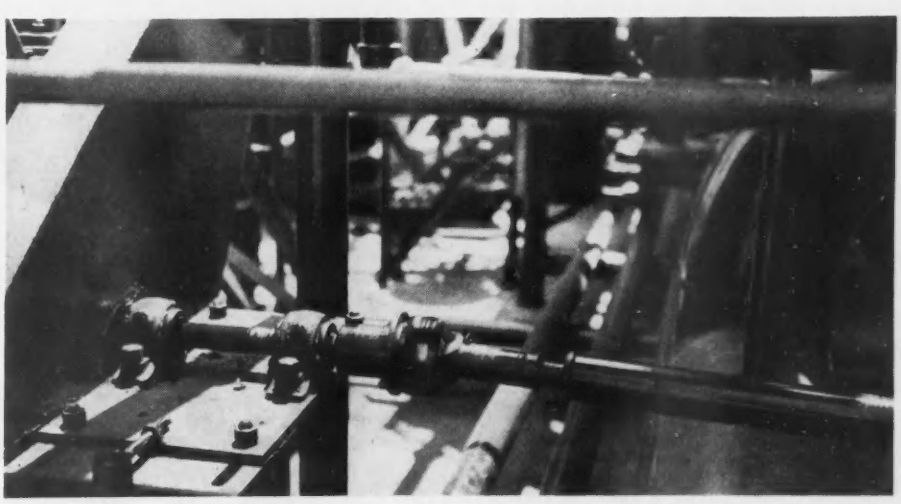
Driving each individual fan without auxiliary power was a problem which was solved by adapting a conventional automobile drive shaft to transmit engine power to the fan assembly without the use of electric motors, or the installation of a central cooling unit to serve all three engines. The crankshaft flange on the flywheel end was prepared by drilling four holes in a concentric circle. The holes were tapped for cap screws to match holes in the conventional automobile drive shaft universal joint companion flange, which would be applied either to the splined shaft of the transmission or to the drive pinion shaft.

The drive shaft is identical to similar units on motor cars, being made of tubular steel and containing facilities for a slip joint sleeve to compensate for end play of the entire unit. The fan assembly, with auxiliary equipment, is mounted on a structural steel pedestal carrying pillow blocks for the jack shaft and the extension of the fan shaft. Final drive is through V-belt so the speed of the fan can be increased above that of the crankshaft of the compressor engine. Adjustment for wear and stretch of the belts is obtained by slotting the plate attached to the top of the pedestal, so that the plate carrying the jackshaft and pillow blocks can be moved horizontally with a jack screw and locked in position with machine bolts. The drive from the main drive shaft is through the second universal joint which is connected to the end of the jackshaft with a conventional companion flange, exactly as the same shaft might be connected to the main shaft of an automobile transmission.

If an engine is shut down, or stops running from other causes, only that engine is affected so far as circulation of cooling water is concerned and rotation of the fan is concerned also. No other engine is affected and no central air circulation unit is necessary. Lubrication of the universal joints is accomplished in a manner similar to that employed when rebuilding an automobile universal joint; disassembling and supplying new needle bearings, cups and crosses. Since the joints are packed, the life of this type of drive should be similar to that expected of the average automobile. Pillow blocks are supplied with pressure fittings and are exposed so that the operator, on his periodic tour of inspection, can fill the bearings with proper greases without difficulty and in safety.



Gas boooster station with radiator jacket water cooling and mufflers set on frames in horizontal position.



Shaft drive for radiator fan cooling for gas booster compressors and engines.

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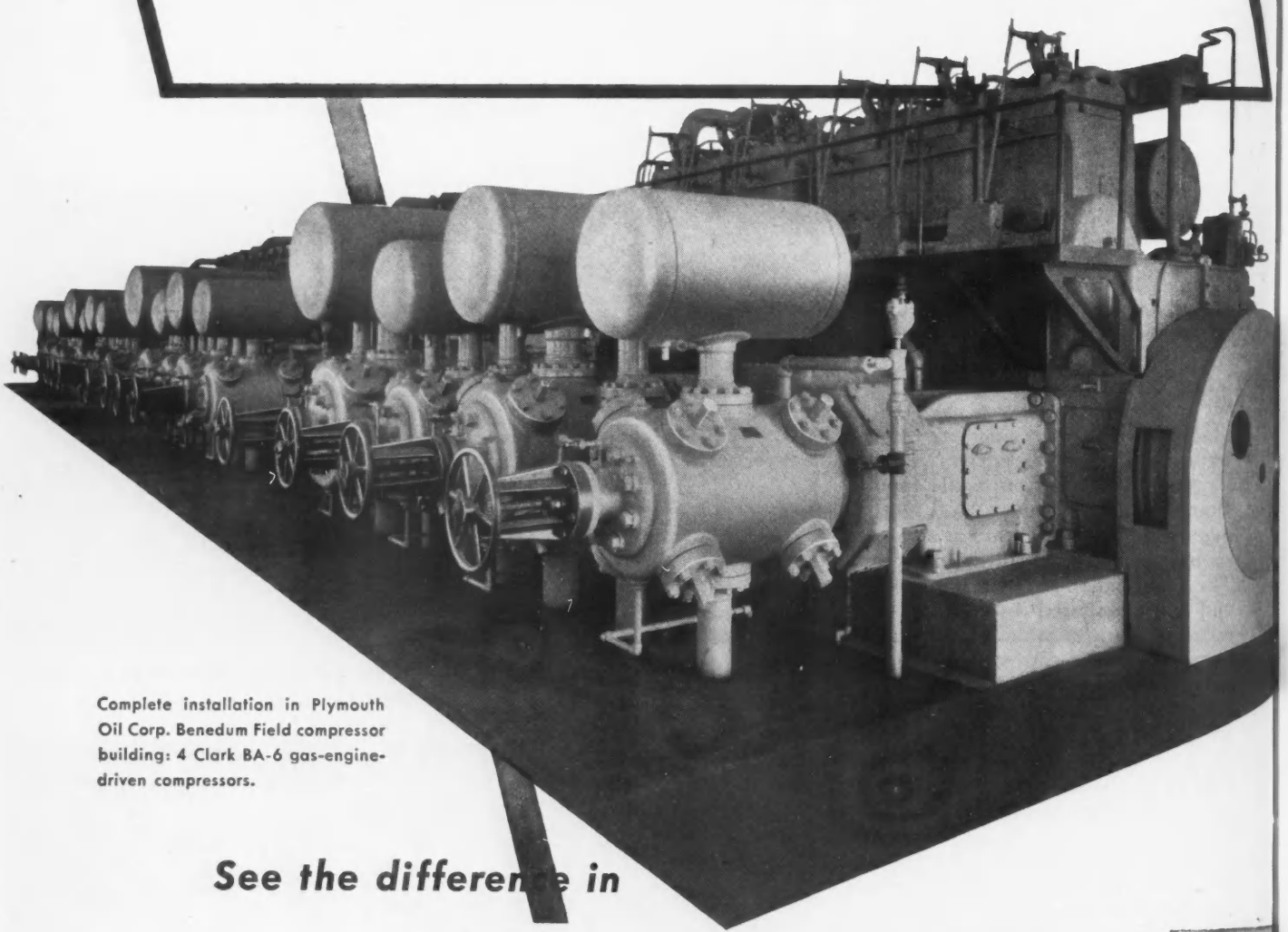
"BIG ANGLES"...



Complete installation in Plymouth Oil Corp. Benedum Field compressor building: 4 Clark BA-6 gas-engine-driven compressors.

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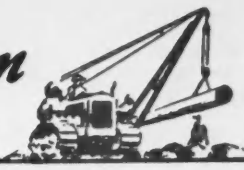
PIPE LINE *Construction*



By SYLVIA LILLIE, Staff Writer

Projects Announced and Contracts Awarded

Crude Oil Lines

Santos Jundiai Railroad has announced plans for 30 miles of 18-inch from Alemca to Utinga, near Sao Paulo, Brazil.

Products Lines

Santos Jundiai Railroad plans 68 miles of six-inch from Campinas to Sao Bernardo, and 30 miles of 10-inch from Alemca to Utinga, Brazil.

Natural Gas Lines

Carthage Natural Gas District of Mississippi has FPC approval to build 16 miles of 4-inch to connect Carthage, Miss., to Southern Natural Gas Company's system in Mississippi. Hyde Construction Company, Jackson, Miss., has the contract.

The Central West Utility Company applied to FPC for permission to construct a 30-mile, 12-inch line from Cities Service Gas Company's facilities near the southeast boundary of Kansas City to Central's distribution system in Clay County, Kansas.

Chickasawhay Natural Gas District of Mississippi plans a 37-mile, six-inch line from Waynesboro to Transcontinental Gas Pipe Line Corporation's line at Stonewall, Miss. Hyde Construction Company, Jackson, Miss., will build it.

Kansas-Nebraska Natural Gas Company, Inc., has application before FPC for approval to build 54 miles of 4-inch, 109 miles of 6-inch, 54 miles of 8-inch, and 5 miles of 10-inch to serve 37 Nebraska communities from its main line. Capacity of the system would be increased from 146 Mmcf to 164,200 mcf daily.

Nevada Natural Gas Pipe Line Company applied for permission to build 114 miles of 10-inch and 7 miles of 4-inch from the east bank of the Colorado River north to Las Vegas, Nev. Gas will be taken from El Paso Natural Gas Company and sold to distributing companies in Needles, Calif., and Boulder City and Las Vegas, Nev.

New York State Natural Gas Corporation was authorized to build a 70-mile, 20-inch line from the Oakford, Penn., storage area to the facilities of the East Ohio Gas Company at the Ohio-Pennsylvania state line.

North Central Natural Gas District of Mississippi has approval to build a 98-mile line to serve various Mississippi towns from Southern Natural Gas Company's system. Distribution facilities will be built in towns and will be leased to Mississippi Gas Company for operation.

Northeastern Gas Transmission Company has been given FPC authorization to build more than 400 miles of line to serve markets in Massachusetts, Connecticut, and New Hampshire.

Piedmont Natural Gas Company, Inc., has authority to lay 74 miles in 6 laterals from Transcontinental's line to city distribution systems in North and South Carolina.

Southeastern Michigan Gas Company has been granted permission to lay a 55-mile, 12-inch line from Panhandle Eastern Pipe Line Company's system in Oakland County to Marysville, Mich., for distributing gas in Macomb and St. Clair counties.

Texas Illinois Natural Gas Pipeline Company has been authorized by FPC to increase its capacity from 305 Mmcf to 374 Mmcf by making certain changes in the units powering its compressor stations and by building 72 miles of pipe line in Texas to deliver additional gas into the main line.

Utah Natural Gas Company has amended its application to the Utah Public Service Commission for permission to build 325 miles of 22-inch from the Four-Corners area to Salt Lake City. It now wants to include 171 miles from the Last Chance area in Emery County to run through Sevier and Sanpete counties to Salina and south to Richfield.

Projects Starting

Crude Oil Lines

Continental Oil Company started in November 40 miles of 2- through 8-inch gathering system in Albert West field, Live Oak County, Texas. F. M. Reising, Edinburg, Texas, is the contractor.

Products Lines

The Texas Pipe Line Company will start work in January on a 56-mile, 10-inch line between Lawrenceville, Ill., and Mount Vernon, Ind. O. R. Burden Construction Corporation, Tulsa, has been awarded the contract.

Natural Gas Lines

Citizen's Gas & Coke Utilities Company started in November 26 miles of 16-inch from Panhandle Eastern's main line to Indianapolis, Ind. Williams Bros. Construction Company, Tulsa, is building it.

DeSoto Natural Gas District of Mississippi is building 24 miles of 4-inch from Texas Gas Transmission's system at the Mississippi-Tennessee state line to Coldwater, Miss. Line will serve the towns of Hernando, Horn Lake, Nesbitt, and Coldwater. Hyde Construction Company, Jackson, Miss., is the contractor.

Lone Star Gas Company started in November 31 miles of 12-inch from Scurry County fields to Sweetwater, Nolan County, Texas. W. L. Golightly Construction Company, Houston, is the contractor.

Phillips Petroleum Company started in early December 39 miles of eight-inch and 11 miles of ten-inch loops between Lyons and Kansas City, Kansas. C. H. Gragg Construction Company, Britton, Oklahoma, is the contractor.

Transcontinental Gas Pipe Line Corporation is building 8.5 miles of 10-inch and 8.5 miles of 30-inch from its main Texas-New York line to Paterson, N. J. Oklahoma Contracting Corporation, Dallas, started in December.

Trunkline Gas Supply Company started work the end of October on 268 miles of 20-inch between McAllen and Altair, Texas. Fulton & Brodie Construction Company, Lubbock, Texas, is the contractor.

Western Natural Gas Company started in December a 55-mile, two- through six-inch gathering system in Live Oak County, Texas. Stuart Pipe Line Construction Company, Beeville, Texas, is the contractor.

Projects Completed

Crude Oil Lines

Amarillo Oil Company completed in November 12 miles of 10- and 12-inch across the Canadian River north of Amarillo. Brodie Construction Company, Amarillo, was the contractor.

The Ohio Oil Company completed in December 54 miles of 20-inch between Wood River and Patoka, Ill. Conyes Construction Corporation, San Pablo, Calif., was the contractor.

Products Lines

Phillips Petroleum Company completed in December a 155-mile, 6-inch line between La Junta and Denver, Colo. Cheek Construction Company, Ulysses, Kansas, was the contractor.

Susquehanna Pipe Line Company completed in December 125 miles of 8-inch from Sun Oil Company's refinery at Toledo, Ohio, to Sarnia, Ontario. H. L. Gentry Construction Company, Jackson, Mich., was the contractor.

Natural Gas Lines

Acme Natural Gas Company completed in December 25 miles of 6-, 8-, and 10-inch to supply three Butler, Penn., industrial consumers. Williams - Austin Company, Pittsburgh, was the contractor.

Alabama-Tennessee Natural Gas Company completed in November 35 miles of 8-inch between Muscle Shoals and Decatur, Ala. Lehman, Hoge & Scott, Harlingen, Texas, was the contractor.

Central Kentucky Natural Gas Company completed in December a 41-mile, 20-inch loop from North Means to Foster, Ky. Williams-Austin Company, Pittsburgh, was the contractor.

City of Danville completed in November 14 miles of 6- and 8-inch from Transcontinental's main line to the city storage tanks. M. L. Bles Construction Company, Danville, Va., was the contractor.

Dow Chemical Company completed in December 27 miles of 12-inch between Midland and Loomis, Mich. Mahoney Contracting Company, Mount Pleasant, Mich., was the contractor.

Hope Natural Gas Company completed in December 20 miles of 18- and 20-inch from its Tonkin compressor station in Doddridge County, W. Va., to the Fink storage area. Pipe Line Construction & Drilling Company, Camp Hill, Penn., was the contractor.

Lion Oil Company completed in November a 70-mile gathering system in Diamond "M" and Sharon Ridge fields, Scurry County, Texas. George Tucker Pipe Line Construction Company, Odessa, Texas, was the contractor.

New York State Natural Gas Corporation completed in December 21 miles of 20-inch from Murrysville, Westmoreland County, to Bakerstown, Penn. Williams-Austin Company, Pittsburgh, was the contractor.

Northern Natural Gas Company has completed 442 miles of 26-inch and 155 miles of 20-inch loop line between the Texas Panhandle and Minnesota. Loop 1—40 miles of 26-inch northward from a point 29 miles north of Skellytown, Texas; Loop 2—75 miles of 26-inch from the Beaver, Okla., station; Loop 3—33 miles of 26-inch from the Mullinville, Kansas, station; Loop 4—72 miles of 26-inch from Bushton to Concordia, Kansas; and Loop 5—155 miles of 20-inch from Garden City, Kansas, to Bushton, were built by R. H. Fulton & Company, Lubbock, Texas. Loop 6—43 miles of 26-inch from a point 29 miles northeast of Palmyra, Neb., to Oakland, Iowa; and Loop 7—66 miles of 26-inch northward from Oakland, were built by Midwestern Constructors, Inc., Tulsa. Loop 8—31 miles of 26-inch southwest from Ventura, Iowa; Loop 9—41 miles of 26-inch northward from Ventura; and Loop 10—40 miles of 26-inch beyond loop 9, were built by Mary Construction Company, Cape Girardeau, Mo.

Northern Natural Gas Company completed in December 99 miles of 4- through 10-inch in the vicinity of Ulysses, Hugoton, and Garden City, Kansas. Reese Bros. Construction Company, Hugoton, was the contractor.

Ohio Fuel Gas Company completed in December 15 miles of 20-inch between Lime City and Woodvile, Ohio. Somerville Construction Company, Ada, Mich., was the contractor.

Pacific Gas & Electric Company completed a 506-mile, 34-inch line from El Paso Natural Gas Company's facilities at Needles, Calif., to Pacific's Milpitas, Calif., terminal. The line has a present capacity of 150 Mmcf, an ultimate capacity of 400 Mmcf. Bechtel-Price-Conyes, San Francisco, finished work in November.

Provident Gas Company built ten miles of four- and six-inch gathering system in Longhorn field, Duval County, Texas. Altgelt Construction Company, Corpus Christi, completed it the end of December.

Southern Natural Gas Company completed in November 32 miles of 16-inch in the vicinity of Wetumpka, Ala. Sheehan Pipe Line Construction Company, Tulsa, was the contractor.

Tennessee Natural Gas Company completed in November 26 miles of 8-, 10-, and 12-inch between Westernia and DuPontia, Tenn. N. A. Saigh Company, Inc., San Antonio, was the contractor.

Transcontinental Gas Pipe Line Corporation completed in late December 109 miles of 24-inch from Falfurrias to Inari, Texas. H. B. Zachry Company, San Antonio, was the contractor.

United Gas Pipe Line Company built 16 miles of 16-inch from its Carthage-Sterlington line to Koran, La. Fowler Brothers Contractors, Minden, La., completed in December. This line, including a 4000-horsepower compressor station at Koran, will carry a maximum of 100 Mmcf daily from the Sligo field into United's Carthage-Sterlington line.

HOUSTON CONTRACTING COMPANY

2707 Ferndale Place

Houston 6, Texas

Latex Construction Company, heretofore engaged in pipe line construction, is now being liquidated and will no longer be active.

Messrs. Laurence H. Favrot and R. P. Gregory have formed a partnership under the name of Houston Contracting Company for carrying on general pipe line and allied construction work, and solicit an opportunity to bid on such work.

Mr. Geo. A. Peterkin will be associated with the new firm.

Mr. J. W. Sharman has decided to retire from this line of business.

December 1, 1950.

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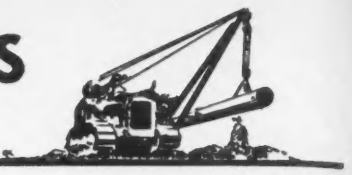
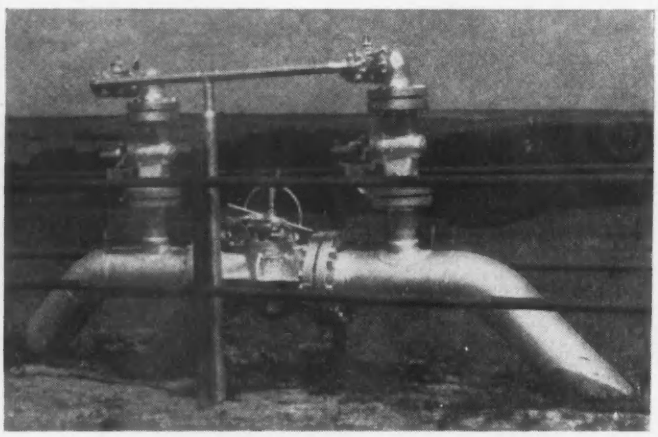
PIPE LINE HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Tap Trunkline for Temporary Gas Supply

From a natural gas pipe line operating under normal pressure in the range of 700 pounds per square inch, it became necessary to take gas for temporary usage without blowing down the line. This was done by connecting a temporary bypass to the flanged bull plugs of the blow-down valves of the nearest above ground gate valve setting.



With the blow-down valves closed, the flanged bull plugs were unbolted and removed. Weld-neck flanges were welded into holes cut in the side of each bull plug. A bypass assembly of proper dimensions was fabricated, and the ends of the two lateral bypass valves were bolted to the projecting mating flanges of the bull plugs. The bull plugs with the bypass assembly attached were then bolted back in their original places atop the blow-down valves of the gate valve setting.

A vertical lead-off tube welded to the under side of the outer section of the bypass conveys gas on into the temporary field lines. By opening both blow-down valves, gas is fed out through the bypass tube from both sides of the main block gate valve. Or if necessary, gas may be taken from one side only by closing the valve on the side not being used.

Ordinarily, if it is known at the time of installation that gas is to be taken from a high pressure pipe line at a certain block gate valve setting, bypass connections are welded to the sides of the horizontal portions of the pipe, just beyond the ends of the main gate valve.

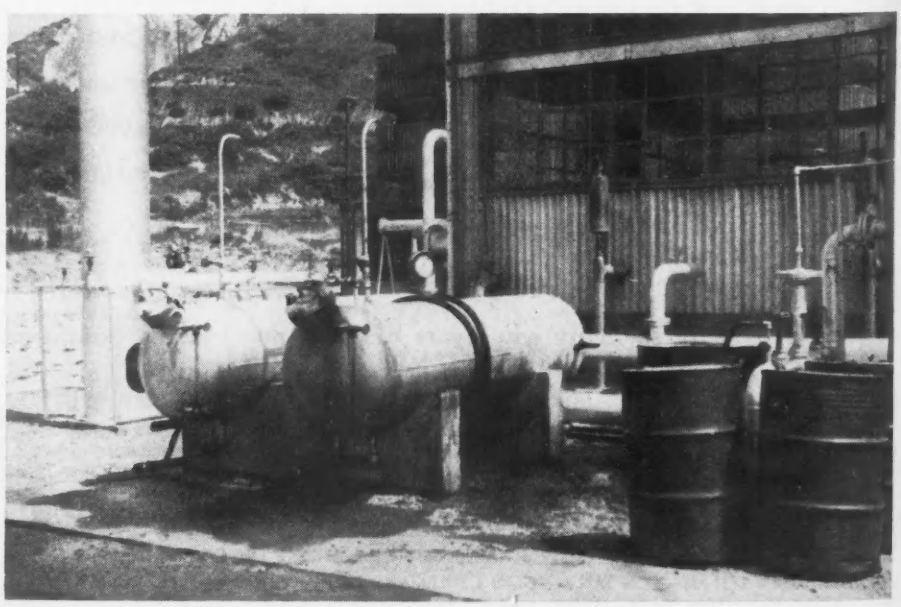
To install such a temporary setup, it is not necessary to take the chance of an accident by attempting to tap into the pressured line; neither is it necessary to blow down the line to install the bypass.

HOW TO—Connect Blowcases for Station Utilities

Blowcases for distilled water, or steam condensate, and lubricating oil are in use at one booster station. The cases, as illustrated, are made of welded steel, and installed horizontally on concrete piers near the operator's walkway for convenience. Each vessel is equipped with a gauge glass.

Water is supplied to the water blowcase from transportation facilities. Air pressure is then applied to the blowcase so the operator can add makeup to the closed jacket water cooling system at such times as it is needed. The water flows from the blowcase under pressure into the cooling system at the vertical column, shown at the left. This vessel is equipped with gauge glasses to permit the operator to check the level of the water.

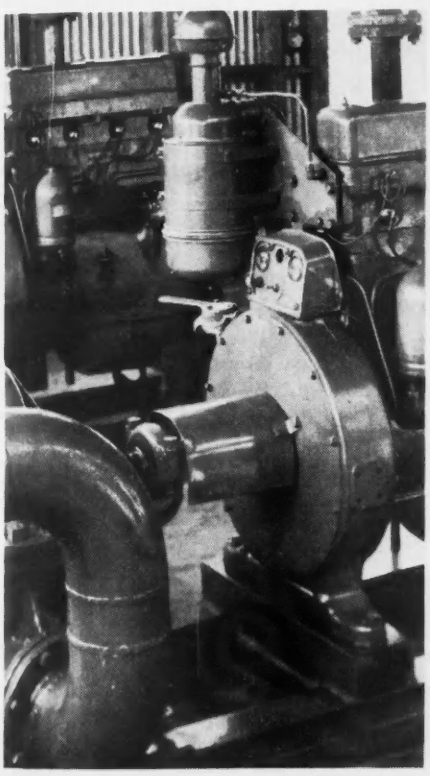
Oil is transferred to the lubricating oil blowcase from the drums by attaching a low pressure air hose to the small bung connection, and inserting a lance with a threaded fitting to the large bung connection. The pressure applied forces the oil from the drum to the blowcase. After the blowcase is filled, it also is placed under air pressure so that the oil will flow to engine crankcases and other points of use.



HOW TO—
Cover Opening Over Flywheel Housing

High-speed industrial engines of relatively small horsepower are finding increased application in pipe line operations because of their compactness, light weight and flexibility. In adapting these industrial engines of 160-180 horsepower and even smaller, it is necessary to remove the clutch assembly which, in most cases, is standard equipment on power units of this type.

In connecting the crankshaft of the high-speed engine directly to a centrifugal pump which circulates compressor cooling



water, it is necessary to provide a cover over the opening around the flywheel housing. A large, sheet steel disc, the size of the housing, is cut and drilled so that holes matched the bolt holes formerly used to attach the clutch assembly to the engine. Short stud bolts hold the plate securely in place.

The shaft of the centrifugal pump is extended a short distance and coupled to the flywheel of the industrial engine. Since the pump and engine are mounted on the same structural skid, the shaft can easily be aligned. The exposed shaft is guarded with a curved piece of light-weight sheet metal with short tabs welded to each end. These tabs are bolted to the cover disc and to the cap bolts on the bearing to provide a sturdy guard against accidental contact with the rotating shaft.

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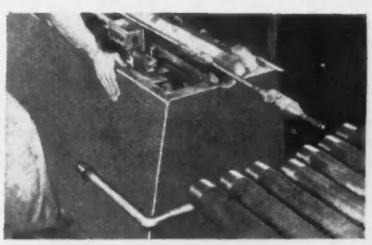

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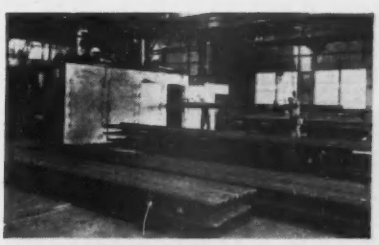

A view of the Tube-Kote baking ovens which can handle over 12,000 feet of tubular goods per hour.

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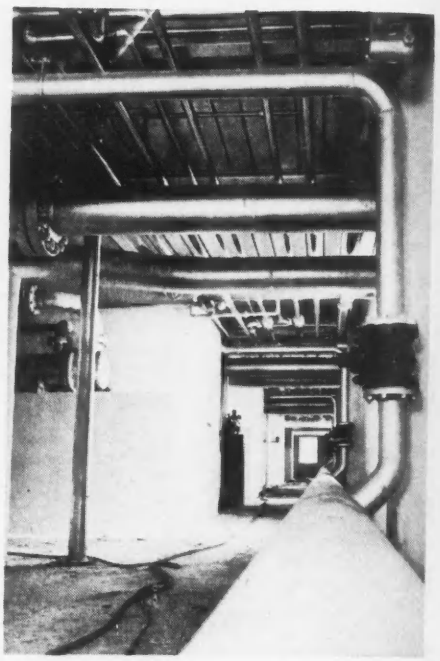
HOW TO—Arrange Piping Layout

Modern trends in compressor station design are toward placing all piping below compressor decks to provide easy access to all machinery. In order to get in and around this piping below the concrete floors, a cellar or basement is necessary. The photo is a view taken below the floors which shows the arrangement of piping to save space and make all pipe easy to service and inspect.

The compressor discharge manifold may be seen in the lower right corner of the illustration, traveling the entire length of the station. To it, the discharge lines from each compressor are attached, with each line equipped with a plug shut-off valve. These lines follow the contour of the basement to make a neat arrangement.

Compressor suction lines are also supported overhead and are the largest lines equipped with flange couplings. The concrete basement wall supports these heavy lines at one point while vertical pipe members carry their weight beyond the flanged section. Utility lines, such as lubricating oil, cooling water, fuel, etc., are transverse to the suction and discharge lines, and are supported by the heavy steel beam joists which hold up the floor around the heavy



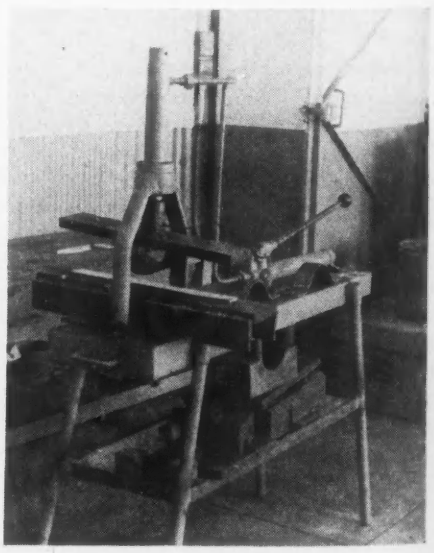
engines and compressors. Maintenance and inspection of the station's facilities are speeded up considerably by such a spacious and efficient arrangement of piping.

HOW TO—Fabricate Pipe Clamps

A hydraulically-operated tool, designed and built to test coupons cut from welding beads, by changing dies can be converted to make pipe clamps. The original purpose of this press was for a bending test of welded strips and coupons cut from test welds in the shop.

The machine has a table fitted with pipe legs set in ferrules welded to the table top. Angle iron cross braces between the legs are placed with the inside of the angle up to retain a sheet metal shelf on which the dies are placed while not in use. The table top is made of heavy sheet metal. A sliding drawer in one end contains small dies and retaining pins, which hold the upper dies to the hydraulic piston. The hydraulic pump at one end of the table has a reservoir cylinder to supply hydraulic fluid to the small pump operated by a long lever.

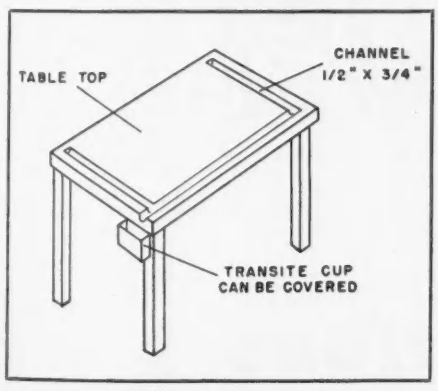
The top die cylinder is mounted vertically on a heavy yoke supported by angle iron strips welded to the table top. The piston in the upper cylinder is fitted with a chuck-type head to hold the top die, which is retained in position for use with a pin. The pin serves only to hold the



dead weight of the top die in the chuck-type head. The pressure exerted by the operating cylinder is against the neck of the top die.

The lower die is made to match the upper one, leaving adequate space between them for the strap of steel used to make the pipe clamp. Both upper and lower halves of the die are wide enough to form various sizes of clamps, but the usual type is the strap iron used for conventional pipe clamps. In operation, the strap steel is cut to the length necessary to form the clamp. When the strip of steel is laid on the lower half of the die, pumping down the top half forms the strap. Bolt holes are then drilled, and the clamp is ready for use. Several sizes of upper and lower dies are supplied with the machine so clamps from one to six inches can be made quickly. When the machine is used as a tester for welding beads, the coupon is placed between dies following the form of conventional bending testers. The upper die is a rounded nose-type which fits into a block of heavy steel shaped to receive the coupon. The coupon receives a sharp bend at the seam the welder laid on the pipe or piece of flat work.

HOW TO—
Conserve Mercury In Filling Gauges



Small channels cut around the edges of table tops where mercury is used in filling gauges, etc., prevents spilled mercury from falling to the floor and being wasted. The mercury drains down the channel in the table into a transite cup at one corner, from which it can be recovered. The cup can be provided with a cover.

The table pictured aids in decreasing the concentration of mercury vapor in the air to a safe level. When spilled mercury reaches the floor and is ground underfoot, the resulting vaporization causes the surrounding air to become toxic.

Sketch and material courtesy of "Coin Your Ideas" Committee, Esso Standard Oil Company, Louisiana division, Baton Rouge.

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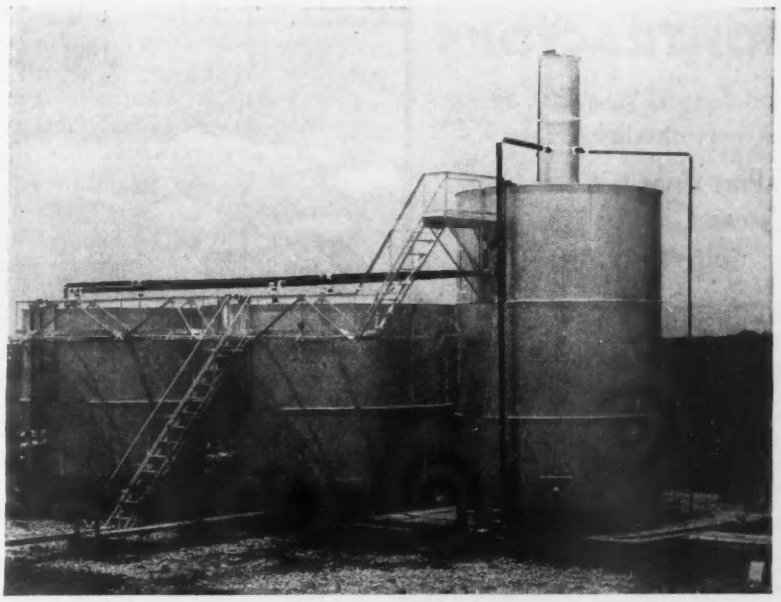

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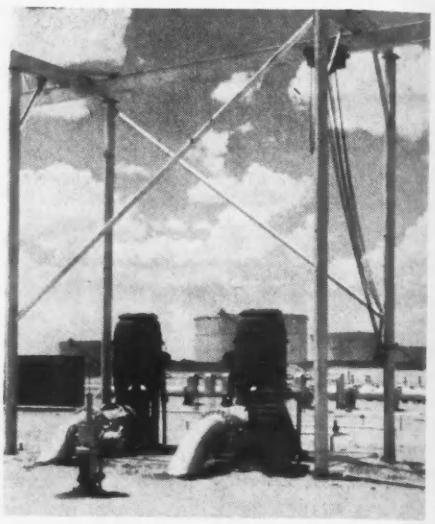
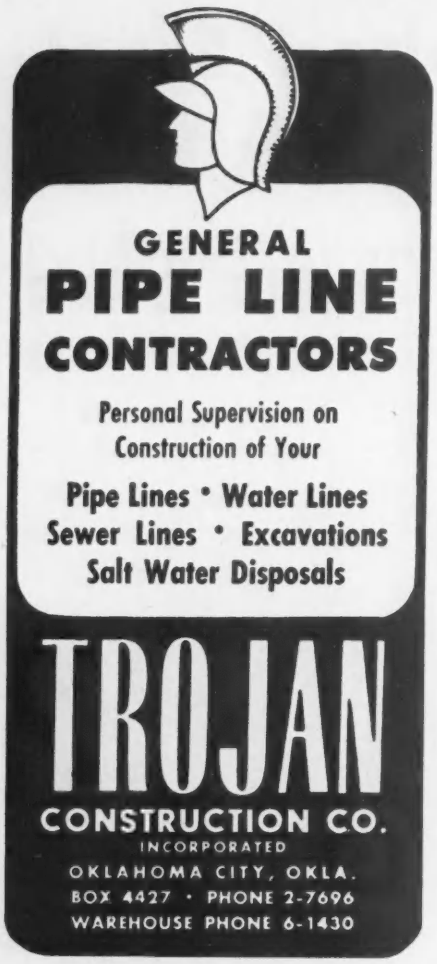
HOW TO—Service Booster Pumps

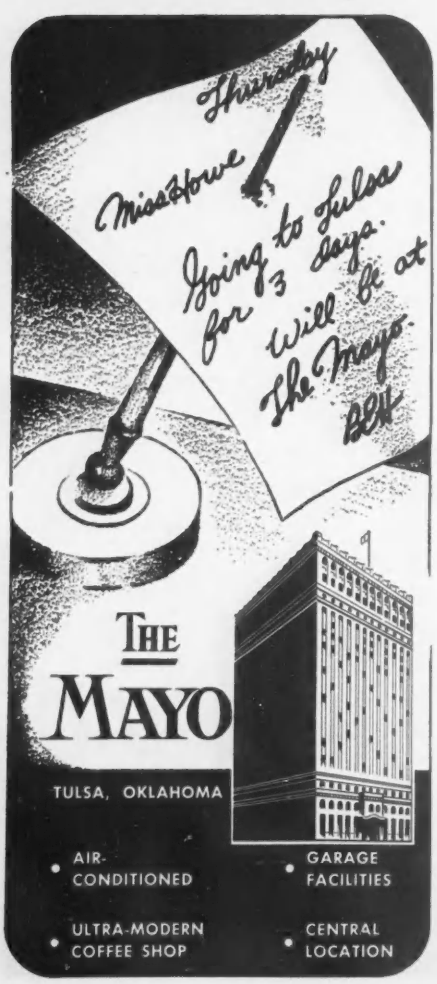
Considerable expense and plant shutdown time is saved by one pipe line company through the use of a large servicing crane framework erected permanently over the two large deep-well booster pumps. These pumps are located in the gravity flow line between storage tanks and the main line pumping station.



Because of the considerable weight of the large 125-horsepower motors which drive the 4820 gallons-per-minute pumps, and which must be removed to service or overhaul the pumps, the permanent overhead craneway enables workmen to start work immediately should a breakdown or other service work require removal of the motors.

The framework provides maximum overhead clearance with a minimum of interference from bracing. Short lengths of I-beam material span the tops of the pipe corner posts at each end of the framework and a length of I-beam forms the craneway. Overhang of the craneway at either end of the framework enables a motor or pump to be loaded directly aboard a truck backed up to the easily accessible installation.





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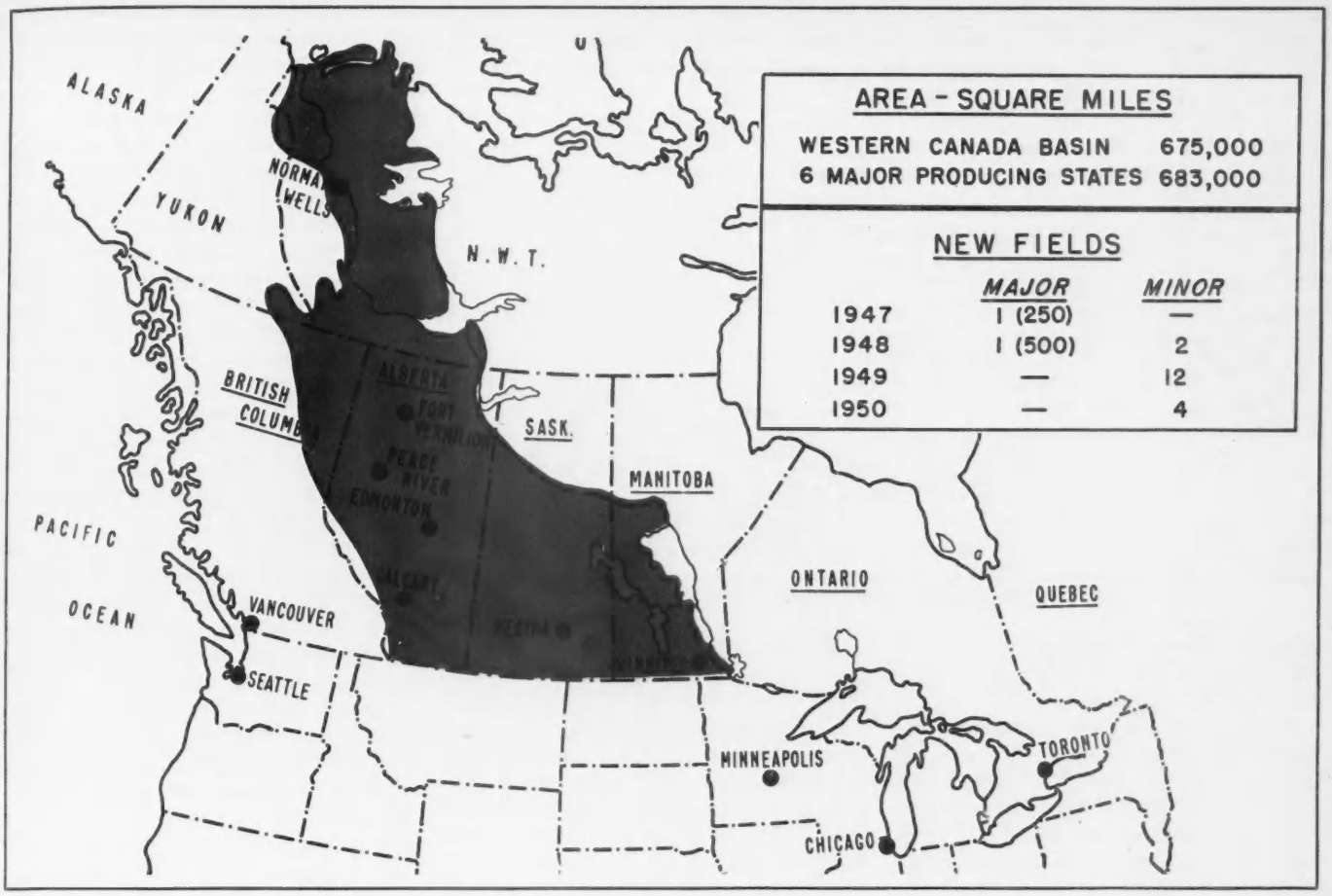


FIGURE 1. Western Canada Basin.

Importance of Recent Canadian Oil Developments

By JOHN F. FAIRLIE
Manager, Coordination and Economics Department
Imperial Oil Limited

BY THE end of 1950 the oil industry had spent $1½ billion dollars in the Canadian prairies since February, 1947. This expenditure was initiated by the discovery of the Leduc oil field, 20 miles south of Edmonton.

In the intervening years, about 1700 producing oil wells have been drilled. New refineries have been built, or are planned, which together with the expansion of existing facilities will have tripled prairie refining capacity, increasing it by some 80,000 barrels per day. A new crude transportation system, 2000 miles long, will move Alberta crude to eastern refineries when spring permits tanker movement of oil from the huge pipe line now completed.

This record of achievement is a typical oil story in its magnitude, in the energy which has been expended in a short period, and the risks which have been successfully overcome. It is characteristic of the industry and of the system on this continent which rewards energy and enterprise.

In considering the significance of oil discoveries since Leduc, it is necessary first to recognize the importance of oil to Canada, and second to determine the relationship of this new supply to industry operations. Oil is peculiarly suited to the solution of Canada's fundamental problems, in overcoming its long distances, in agriculture, in manufacturing, in mining, and in exploiting the great resources of the northern areas.

Canada is currently consuming about 350,000 barrels per day of crude and products. With a population of more than 13.5 million, this amounts to 9.1 barrels per capita per year. This is approximately 60 percent of the U. S. per capita consumption of 15.2 barrels. Petroleum supplies the energy for about 2.5 million vehicles and tractors and it provides the fuel for a power burner or a space heater in one of every six homes. In

THE AUTHOR presents a thorough analysis of the significance of recent oil discoveries in Canada and the impact on petroleum transportation and marketing facilities. This article is abridged from a speech by the author at the meeting of the Petroleum Branch, AIME, at New Orleans on October 4, 1950. The entire speech appears in November, 1950, *Journal of Petroleum Technology*.

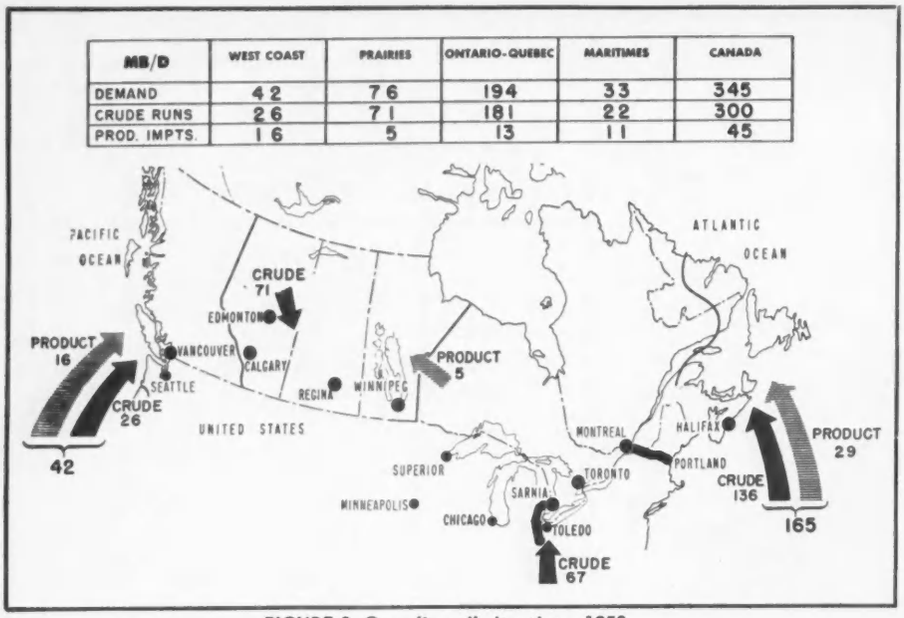


FIGURE 2. Canadian oil situation—1950.

addition, large amounts of oil are used in diesel and oil burning locomotives and in shipping.

In the last ten years, gasoline demand has doubled and heating oil demand has increased 3.5 times. From 1939 to 1949, total Canadian petroleum consumption increased 112 percent as compared with 72 percent for domestic demand in the U. S. That is at almost 1.5 times the American rate of growth. Canada is placing increasing reliance on oil for its energy requirements and it is therefore particularly fortunate that important domestic reserves should have been discovered recently.

At the time of the Leduc discovery more than 90 percent of the country's petroleum requirements were imported from the U. S. and the Caribbean area. Exploration had been carried out over a long period in Alberta but, aside from a few small distillate wells and some wet gas production, no success was experienced until the important crude discovery was made in Turner Valley, 40 miles south of Calgary. In February, 1947, after having drilled 133 wildcat wells in 30 years, and after expending $23 million in exploration, Imperial Oil, Ltd., made the Leduc discovery. With present reserves of 250 million barrels, this field was followed by the Redwater field with reserves now more than 500 million barrels, which in turn was followed by the Golden Spike, Stettler, Excelsior, Campbell, Joseph Lake, Normandville and more recently the Stony Plain-Acheson, Big Valley, Camrose and Whitelaw discoveries. These various discoveries have increased the Western Canada Basin oil reserves in a 3½-year period from 45 million to approximately 1.1 billion barrels (Figure 1).

The activities causing and accompanying this growth are shown in Table 1. The table indicates the potential production at the maximum efficient rate to be 142,000 barrels daily by the end of 1950, or 40 percent of Canada's petroleum requirements. Despite the need for this oil, owing to high rail transportation costs, its utilization is currently confined to the prairies, over and above the amount handled by the recently completed Interprovincial Pipe Line company carrier. As a result, each successful new well at the present time reduces the amount of oil that can be taken from the remaining wells.

Figure 2 shows that Canada is not a homogeneous area but is made up of four separate regions, each with distinct characteristics, each with a different type of economy, and each offering a different supply problem to the oil industry. In the East, the largest concentration of capacity is located at Montreal, amounting to 130,000 barrels per day, or about 40 percent of the Canadian industry. This area is supplied chiefly from Venezuelan and Middle East crudes which are received by a pipe line from Portland and directly by tanker in the summer months.

In Ontario, the largest refinery is at Sarnia with a capacity of about 50,000 barrels per day, which is supplied directly by pipe line from the Mid-Continent and Illinois fields. Other refineries are in the Toronto area for which the general crude supply is imported from U. S. lake ports by tanker. Quebec and Ontario are the most highly populated areas in Canada, and are the major contributors to the national economy with their large manufacturing, agricultural, forestry and mining resources.

The prairie sections of Canada in 1950 were being supplied almost entirely from their own crude resources run in local refineries. However, a small amount of imports is still necessary owing to a lack of plant capacity. Prior to Leduc, the prairies were a high cost area dependent on imported crude and products for the major part of their requirements. Two-thirds of these requirements were met from crude run in a network of small refineries with capacities of 300 to 10,000 barrels per day. Half the crude came from the Turner Valley field in Alberta and the other half was imported by tank car from Montana and Mid-Continent fields. The remaining third of the requirements was supplied in product form through the lakehead from Eastern Canadian refineries running U. S. and Venezuelan crudes.

Transportation from the Mid-Continent area to Regina cost roughly $2.50 per barrel so that crude is delivered at more than $5 per barrel. The cost of moving products from the head of the Great Lakes to Winnipeg exceeds $2 per barrel. Thus, moving a barrel of product from Sarnia to Winnipeg or a barrel of U. S. crude to Regina costs roughly twice as much as it does to move a barrel of Middle East crude 8000 miles from the Persian Gulf via the Suez Canal to New York.

British Columbia's refining capacity is relatively small and both crude and products are imported from California. Obviously then, the distribution of Canada's petroleum supply from the sparsely settled prairies to the oil-short eastern industrial areas poses a great problem. Adequate transportation facilities and possible future markets will occupy the oil industry for the next few years.

It became evident as Leduc was delineated and with the subsequent discovery of Redwater that sufficient crude existed to meet prairie require-

Table 1
Canadian Prairie Oil Development

	1946	1947	1948	1949	1950 Est.
Lease and Reservation, mm Acres	20	30	56	115	140
Geophysical Parties	11	23	59	105	125
Exploration and Development Cost mm $	12	25	50	100	150
Oil Wells Completed	59	196	249	580	700
Reserves mm Bbls.	45	150	500	900	1100
Production Potential MB/D	19	24	40	109	142

ments and to justify an economic pipe line movement from the area. However, the first step was to expand prairie refining capacity to meet the local requirements and to increase crude outlets as quickly as possible. Since no refining capacity either in the U. S. or in Canada could be economically reached by rail, the second step of constructing a pipe line was urgent to draw off production which would otherwise suffocate the industry as fresh reserves were proved up and allowables were cut back.

The outlook for a pipe line to the West Coast was discouraging. At the end of 800 to 1000 miles of difficult and expensive pipe-lining through the Rocky Mountains lay the Vancouver market for about 30,000 barrels per day of light crude with refining capacity for only two-thirds of this. The normal supply for the area was California crude which laid down at Vancouver at approximately $3.06 per barrel. On the basis of a pipe line movement for the Canadian market only, the transportation costs were too high to be economically attractive to the Alberta producer.

To obtain an economical pipe line movement a large throughput was required of the order of 60,000 to 100,000 barrels per day. This volume could not be attained by exports to the U. S. because insufficient refinery capacity exists in Washington and Oregon. While Canadian oil could provide an incentive with a large crude movement for the relocation of refinery capacity from California to the northwest, the pipe line could not wait on such a development in view of the need for an immediate solution.

To the east on the other hand, a large market existed for about 70,000 barrels per day in the Ontario refineries at Sarnia and Toronto which could use the crude as quickly as it was made available. To enter this market it would be necessary to lay down crude of equivalent quality at the same cost as normal U. S. supplies, or at $3.20-$3.25 U. S. per barrel. This, less the transportation cost, would determine the field price in Alberta. Since the prairie crude price was initially established at a level competitive with alternative supplies in the prairie refining centers, a reduction in field price would be required. With due consideration for the problems involved, the Interprovincial Pipe Line Company was formed and the pipe line to the east was built. Details of the line appear in WORLD OIL for August and December, 1950.

Figures 3 and 4 illustrate the potential Canadian movement of oil in terms of volume and price with the possible available markets for the crude when output is increased. The data are based on rough estimates aimed at conveying the relative situation. Definite estimates or changed circumstances may significantly alter the absolute relationships. The netbacks have been based on economical pipe line movements of 100,000 barrels per day. The tariff of 17 cents reflects the assumed U. S. import duty following abrogation of the Mexican Trade Agreement. Market requirements have been arbitrarily placed on a 1955 basis.

The Ontario market, on the basis of existing and planned capacity, offers an outlet for 90,000 to 100,000 barrels per day. The netback indicated for Ontario determines the field price and this in turn will establish the value in other competitive markets. With the Ontario netback as a basis, an incentive may be provided to construct capacity in a market such as Minneapolis. Alternatively, if this does not provide the required incentive, it may be desirable to lower the field price to meet competition in the new market, if the additional outlet obtained compensates the producer for the lower field price. If this should occur, the new market would establish the basis and the delivered price to Ontario would be reduced below the competitive value with benefit to product prices in the area.

To expand the crude outlet further, beyond that offered by Ontario and the area tributary to the lakehead

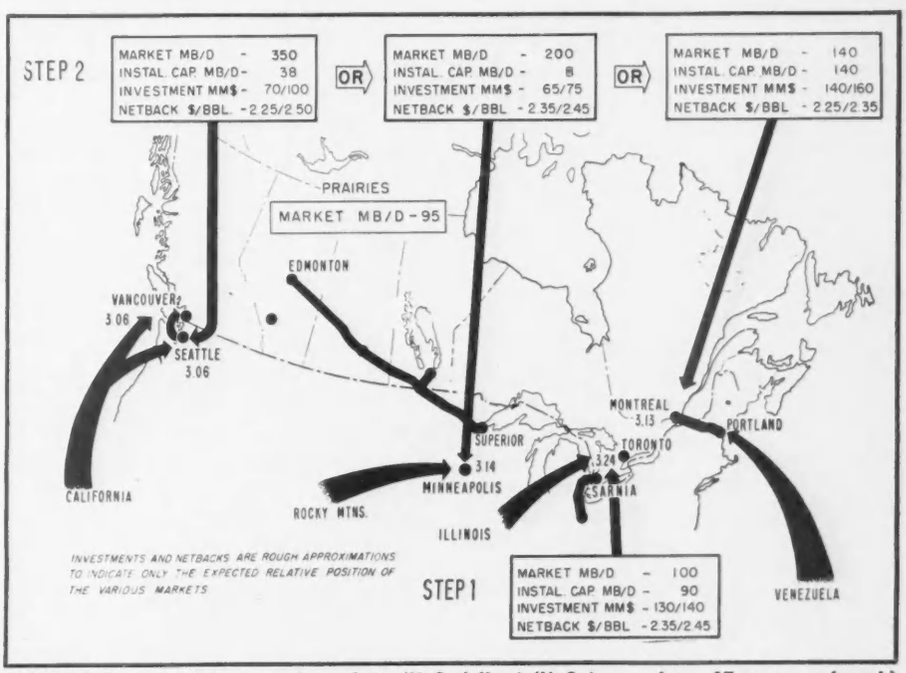


FIGURE 3. Potential Alberta crude markets. (U. S. dollars) (U. S. import duty—17 cents per barrel.)

MB/D	WEST COAST	PRAIRIES	ONTARIO-QUEBEC	MARITIMES	CANADA
DEMAND	44	81	206	36	367
CRUDE RUNS	25	81	185	19	310
PROD. IMPTS.	19	—	21	17	57

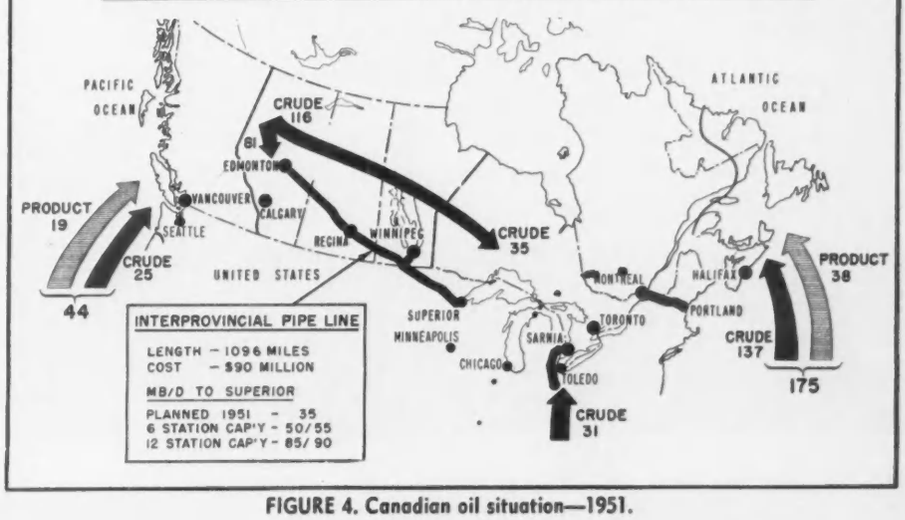


FIGURE 4. Canadian oil situation—1951.

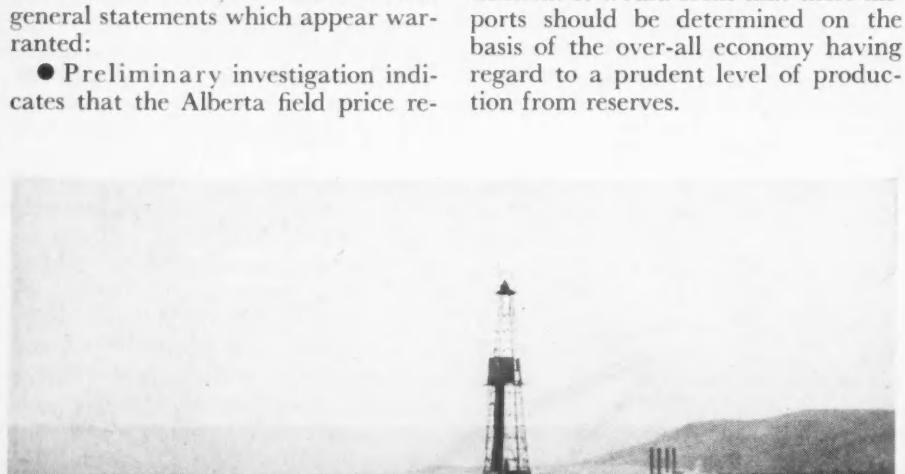
terminus, requires the development of a new market. The Pacific Northwest states are indicated to have a large demand equivalent to about 350,000 barrels of crude per day. There is no important refinery capacity in the area and it is currently supplied by products from California. Refinery construction appears desirable to meet the needs of the rapidly growing Northwest states, and its logical and most economical supply would seem to be from a crude source 800 miles away rather than from the probable future movement from West Texas through California, a distance of 2000 miles.

A further factor which may influence the movement of Canadian crude to the Pacific Coast is the strategic consideration if it becomes desirable to provide for the support of military operations in the Orient from a Canadian source or, if for this reason, additional demands are placed on California.

The other alternative markets are shown on Figure 3 and each has its possibilities and drawbacks for Canadian crude movement.

Beyond this broad discussion of the general situation, it would be unprofitable to speculate more definitely on which market or combination of markets will ultimately be the outlet for prairie oil. These will be determined by the competitive and supply situations at the time when the outlet is required and by other factors such as continental supply and demand, tariff developments, strategic considerations, and the rate and size of future discoveries both in the U. S. and in Canada. However, there are several general statements which appear warranted:

- Preliminary investigation indicates that the Alberta field price required to compete in the various possible markets does not vary greatly between markets.
- While pipe line investments to reach the markets vary, the difference may not be significant since tariffs provide for a return on the investments.
- After the saturation of the Ontario market, the effect on Canadian crude of any changes in the U. S. tariff will probably be the same for all destinations; that is, assuming that Caribbean supplies are priced to reflect such a development.
- There are substantial differences in the size of markets, the West Coast being the biggest. On the other hand, the largest amount of refinery capacity in existence at the present time is at Montreal. For both the West Coast and Minneapolis a substantial refinery investment must be made to provide a sizeable crude outlet. However, in the future, prairie crude may prove to be the most logical supply to these markets and it may be desirable from an over-all supply standpoint for it to be priced at the level necessary to provide the inducement for the required refinery investment. In view of the large annual growth in continental demand, the opportunity should readily occur for a relocation of capacity to conform with a more favorable supply.
- The North American continent should be viewed as a unit from an oil supply standpoint. It is generally recognized that imports to the continental area will be necessary from now on to supplement domestic production. It would seem that these imports should be determined on the basis of the over-all economy having regard to a prudent level of production from reserves.



This view shows the second well drilled on Jumping Pound Structure, about 25 miles west of Calgary, Alberta.

British Columbia Receives Gas Through Alberta Line

A four-inch pipe line began deliveries of natural gas from the Pouce Coupe field in northwest Alberta to Dawson Creek, British Columbia in November. Ceremonies marked the opening of the 15-mile line which made the first export of Alberta gas to another province.

Built by Westcoast Transmission Company, Ltd., of Calgary, the line is intended to be the first link in a carrier to be built by the same company to the Canadian and U. S. Pacific coastal area. If permission is obtained to build this longer line, it will extend from the Pouce Coupe area down through British Columbia, serving Canadian cities en route, and will cross the International boundary at Sumas, Wash. In the U. S., the Alberta gas would service Seattle, Tacoma, Spokane, the atomic energy plant at Hanford, and would probably extend to and beyond Portland, Ore.

The location of the proposed pipe line is believed to be the cheapest and most convenient route for Alberta gas to reach the Pacific Coast region. Exploration for oil and gas is now going on in British Columbia, in the area around Dawson Creek, and any production found there would make a pipe line necessary in the future.

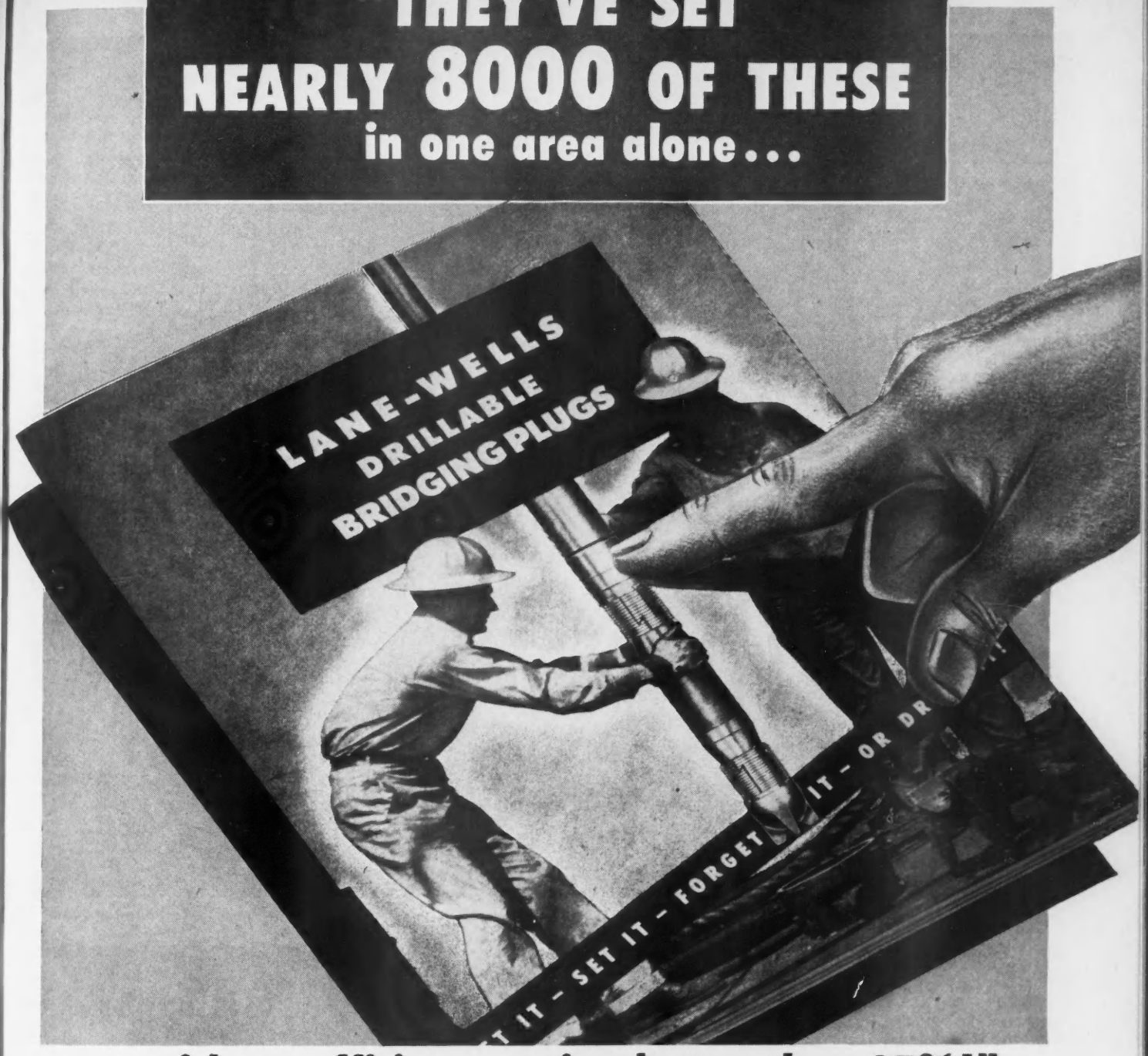
Exploration Encouraged By Cuban Government

Cuba has taken action to step up oil exploration in the island's six provinces. Among the measures will be tax easements on companies active in oil development; technical coordination through a non-political Bureau of Mines to be created; the hiring of U. S. geologists; and possible financial participation if necessary. Dr. William B. Mather, of the Southwest Research Institute at San Antonio, Texas, is expected to return to Cuba soon to aid the government in its program to develop its natural resources.

With domestic oil production a little less than 300,000 barrels per year, Cuba consumes about 12.5 million barrels annually.

For the past two years preliminary geological surveying has been carried on for the Cuban-Venezuelan Oil Voting Trust. Working in all portions of the island and parts of the continental shelf for the Trust, Oil Properties Consultants of Pasadena, under the direction of Rene Engel, has indicated that many sections of the island are favorable to oil accumulation.

"THEY'VE SET NEARLY 8000 OF THESE in one area alone...



...with an efficiency rating better than 95%!"

"Of course, it was a big area, but a bridging plug that can make that kind of efficiency record, under the many different well conditions it must have met in a big area, is certainly something to keep in mind.

"The Lane-Wells man tells me this plug has been tested under some exceptional conditions. It has held a pressure as high as 10,000 p.s.i. and the temperature tests have run as high as 300° F. He points out the long, self-sealing packer element and the large interlocking slips as a couple of reasons why. The record certainly seems to back him up.

"Other operators tell me they like Lane-Wells drillable bridging plugs because they run easily and quickly, and because they can be knocked down or drilled up in quick time — 4 to 6 hours will drill them out, with rotary or cable tools. When you add up all the construction features of this plug, it's easy to see how it made such a record . . . and why so many operators prefer it to any other!"

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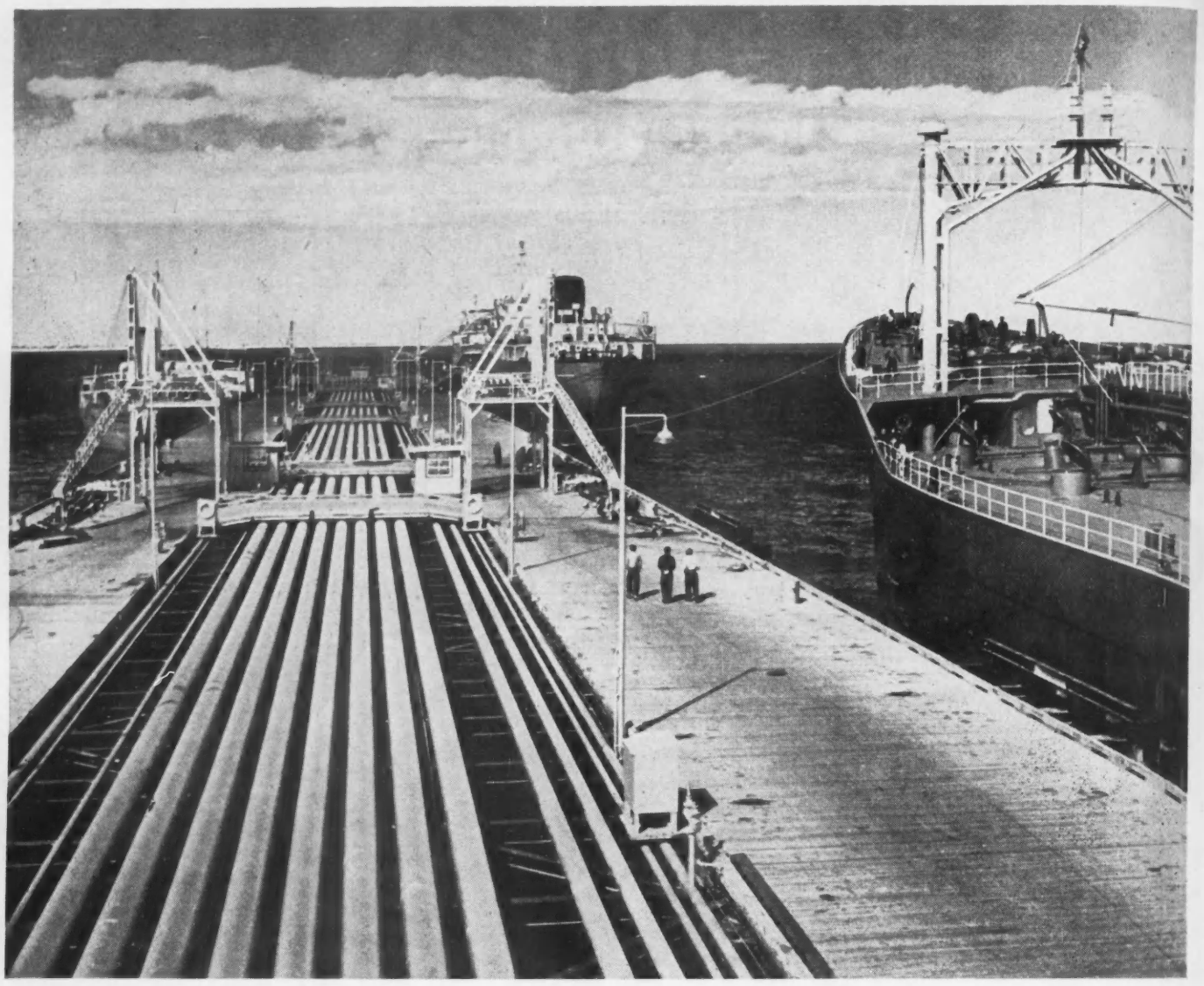


Tankers loading at the oil pier.

MENA AL AHMADI . . .

Kuwait Oil Company's Port

KUWAIT Oil Company's loading pier—largest of its type in the world—can berth six tankers at once and load them with crude at a rate of more than 70,000 tons every 24 hours. It also has two berths for ocean-going cargo vessels. The pier is at Mena al Ahmadi, nearest point on the coast of Kuwait to the company's town at Ahmadi.

The approach trestle, which carries the pipeway and 24 feet wide roadway, is 4140 feet long and 49½ feet wide. At its head, extensions to the north and south form the oil loading and cargo berths. The northern extension has a length of 2805 feet and a width of 105 feet and the southern extension for cargo vessels has a length of 1077 feet and a width of 100 feet. The main structure of the pier consists of 3851 steel piles—14-inch H-beams weighing 73 pounds a foot and averaging 90 feet in length, each of which was coated with hot coal-tar enamel before being driven into the sea bed. In addition to the piles themselves there are 65,300 assorted pieces of structural steel, all the joints of which are welded. There are more than 2 million board feet of timber in the decking alone, and another million in fenders, curbs and railings. Every piece of steel was sandblasted, coated or painted and every piece of timer was given preservative treatment.

The superstructure includes two office buildings, a compressor and storage building, several fire-protection pumping stations, six double stiff-leg hose-handling derricks, four 6-ton portal cranes and a 60-ton stiff-leg derrick.

The pipeway carries eight 24-inch crude oil lines, one 16-inch line for bunker fuel oil and one 12-inch diesel-fuel line. Besides these there are many smaller lines for fresh water, salt water and compressed air. Together, these lines make it possible to load six tankers simultaneously with crude, to supply them with fuel and fresh water, to provide a temporary supply of sea water to the nearby refinery and to afford fire protection.

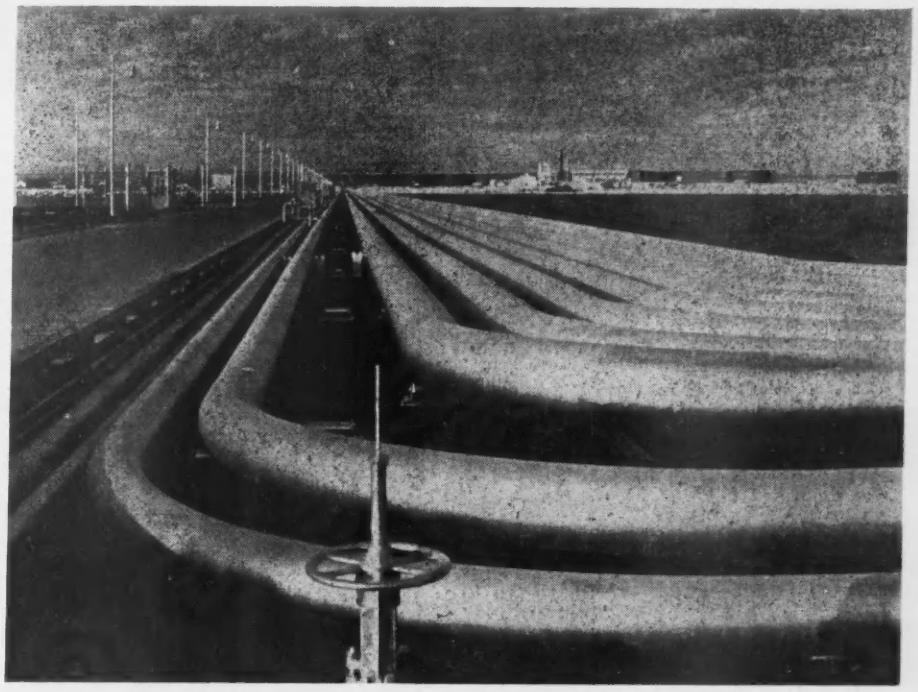
The pipe lines are anchored at the shore end by a large concrete block and are carried on rollers to the pierhead where movement caused by con-

traction and expansion is permitted at an S-bend. That ample allowance must be made for such movement is apparent from local meteorological records. A maximum of 170° F. (in the sun) in summer and a minimum of 30° F. in winter is not abnormal.

Of special interest are the gravity fenders with which the oil and cargo piers are fitted. Since the coastline affords no protection against bad weather, it was necessary to find means to safeguard both the pier, and the ships using it, from damage in high seas. For this purpose the company decided to use a type of suspended fender invented by Professor A. L. L. Baker of the Imperial College of Science, London, adapted for the conditions obtaining at Kuwait. First installed on a jetty at Heysham, England, during World War II, the fenders were adapted for "Mulberry" harbors to enable LST's to berth at a speed of four knots without damage.

The fenders in use at Kuwait consist of three cylinders, each measuring six feet in diameter and 21 feet 3 inches in height, filled with concrete and weighing 50 tons. It was estimated that a set of three of such cylinders together, suspended at the top and bottom on links between trunnions, could cushion and resist a pressure of 250 tons by swinging inward (and upward) on the impact of a vessel. Faced by 14-inch timbers, the sets of cylinders are spaced at intervals of 135 to 165 feet. There are 44 sets.

Corrosion is a serious problem in the waters of the Persian Gulf, and to supplement the coal-tar enamel protection against this menace, a cathodic system has been installed by the company. A huge wet cell has been created by immersing magnesium anodes in the sea water alongside the steel piles, these becoming cathodes when connected through a current-limiting resister. The current breaks up the electrolyte (the sea water) so that hydrogen ions are deposited on the steel to form a corrosion-resistant film. The magnesium anodes are gradually eaten away while the steel remains intact.

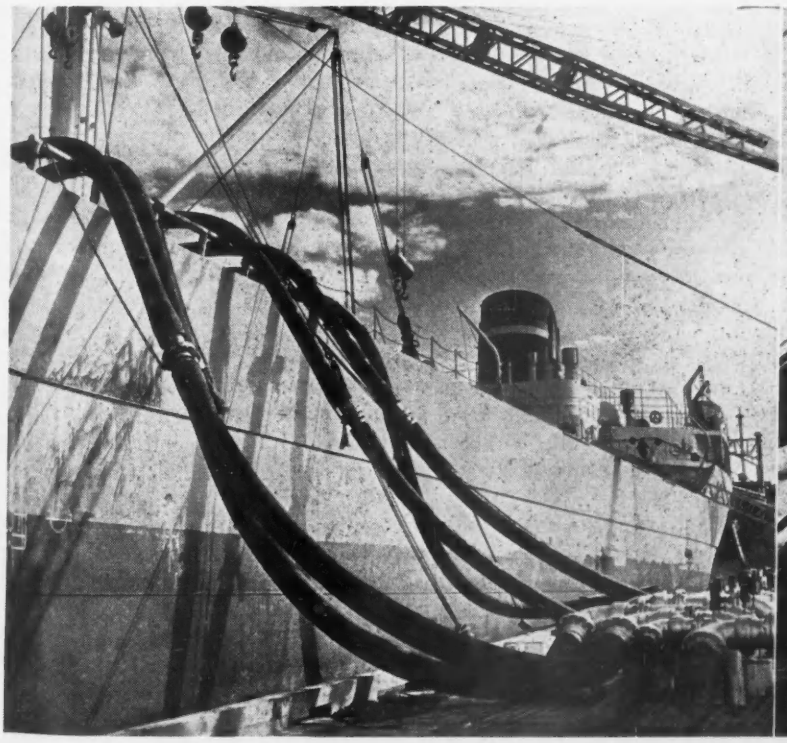


The pipeway and roadway seen from the pier head.

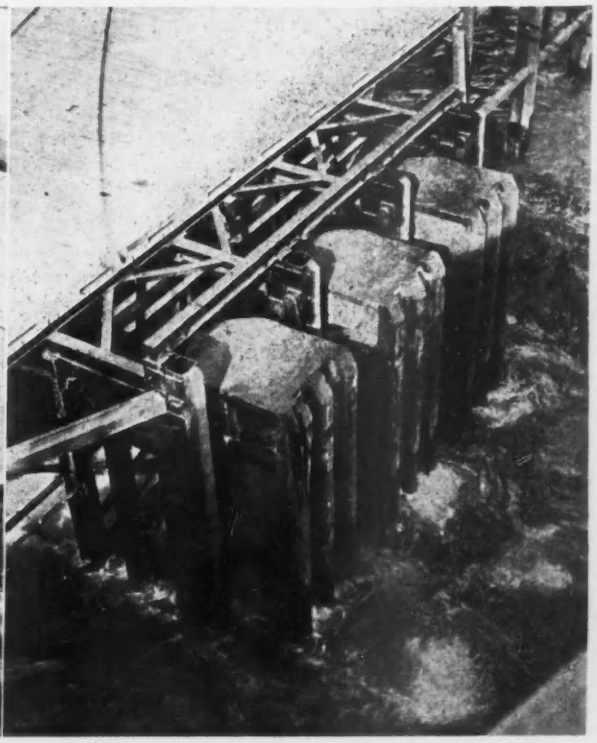
The entire pier, composed of nearly 38,000 tons of materials, is designed and engineered for maximum safety and longevity and was completed in just under 18 months. In the short time that the pier has been in use, its loading capacity has more than fulfilled expectations. One of the world's largest tankers was recently loaded with 26,303 tons of oil in 7 hours 14 minutes.

ACKNOWLEDGMENT

This article is reprinted courtesy of *Naft* Magazine, published by The Anglo-Iranian Oil Company, Ltd.



Oil feed lines coupled for loading.



The Baker fenders.

Tampico Embayment

—Mexico's Fabulous Area of Oil Production

By CLARK MILLISON
Geological Consultant, Petroleos Mexicanos
and Partner in Manhart, Millison and Beebe, Tulsa

MEXICO'S TAMPICO area rapidly forges ahead in production and reserves. Mexico ranked fourth in cumulative production in the world at the end of last year and now rates seventh in terms of daily production. Development of its vast potential reserves has proved to be such an enormous task that the Mexican government has recently contracted several U. S. firms to assist in an expanded oil exploratory program. This authoritative geological analysis of Mexico's main oil area illustrates that encouraging returns may result from the work.

MEXICO ranks seventh in world oil production, and since the beginning of the twentieth century has been among the leaders because of the rich oil deposits of the Tampico Embayment. Of the approximately 2.5 billion barrels of oil produced in Mexico, more than 2.25 billion have come from the Tampico area. The present daily average production in Mexico is about 200,000 barrels, and about 165,000 barrels come from the Tampico region.

The Tampico Embayment is in East Central Mexico and is bounded on the north by the Sierra Tamaulipas, on the west by the Sierra Madre, on the south by the Teziutlan massif, and on the east by the Gulf of Mexico. It is approximately 200 miles long and 90 miles wide, an area about the size of West Virginia. About 6000 wells have been drilled in this area, and at the present time, there are 58 drilling wells, 40 of which are development wells.

First oil discovered in Mexico was in the Tampico area in 1904. During the last 46 years, continuous drilling and exploration has been under way. Most of the oil has been produced from the Tamaulipas, Tamabra, and El Abra limestones (approximate age equivalents) of Middle Cretaceous age, but about 10 percent has been produced from limestones of Upper Cretaceous age. All of the oil has been found in anticlinal structures, although different types of porosity and permeability account for the accumulation.

There are about ten oil pools in the embayment, but only four are significant. These four, Panuco-Ebano, Golden Lane, Poza Rica, and Moralillo, account for most of the past and present production. Each is a distinct type of oil pool, and each displays a different manner of oil accumulation.

PANUCO-EBANO: The first oil well was drilled in the Panuco-Ebano area in 1904. Since then, 4472 wells have been drilled, of which about 1700 produced oil. Two factors explain this high dry hole ratio. One is that most of the oil is accumulated in fractures in the Upper and Middle Cretaceous dense limestones on a broad, southward plunging anticlinorium. To illustrate the vagaries of accumulation, one well in the East La Dicha area had an initial production of 25,000 barrels per day and produced a total of 4.5 million barrels of oil. Five offsets, less than 300 feet distant, were either failures or marginal wells. The second factor is that during the first 30 years of the development of this pool, a well had to be a large flowing well or it was abandoned. During the last ten years, Petroleos Mexicanos and some individuals have been drilling and completing these smaller wells which would have been plugged in the early days.

Panuco-Ebano has produced to the first of this year a total of 813,026,233 barrels of oil. At the present time it is producing about 25,000 barrels daily, and there are 11 drilling wells. Pemex has completed 14 oil wells in a new area on the west flank and is carrying on an active exploratory campaign to find additional production and reserves. One well, Chijol 1012, is drilling below 3000 feet in an effort to discover new deeper production in the pre-Cretaceous beds. Depth of the present production ranges from 1500 to 2500 feet.

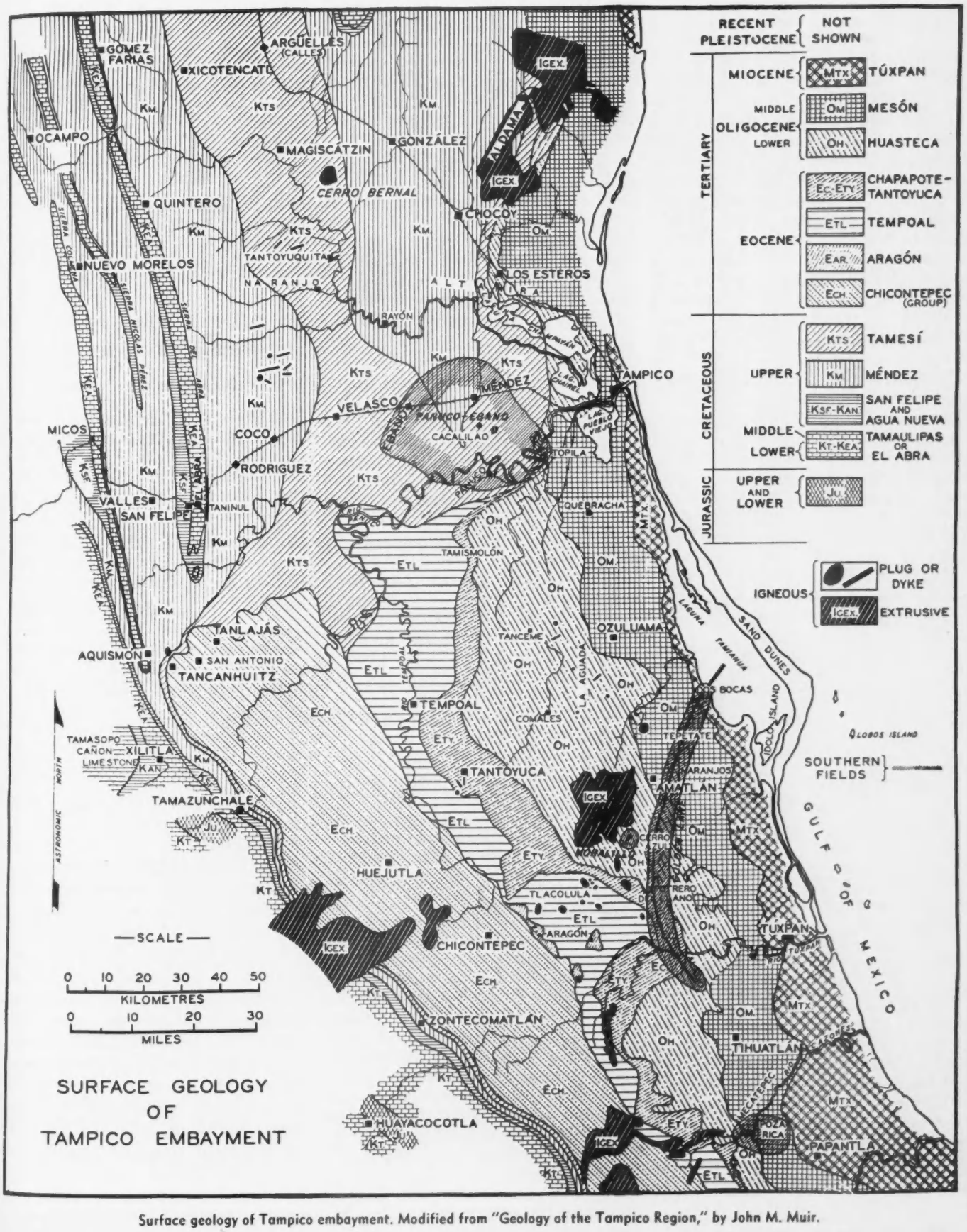
GOLDEN LANE: First oil was discovered in the Golden Lane in 1908. Subsequently, 1301 wells were drilled, of which about 600 were producers. A total of 1,097,169,117 barrels of oil was produced from this elongated pool to the first of this year. There are nine drilling wells at present. Since 1948, Pemex has completed about 50 new oil wells in this old pool and added about 12,000 barrels to the daily production. New discoveries are being made which will continue to maintain this pool as one of the outstanding oil accumulations of the world.

Production is obtained from the El Abra limestone, a reef facies of the middle Cretaceous. One well has penetrated 8396 feet into the reef without finding the base. The reef has the characteristics of a barrier reef which at present plunges from the center toward the extremities, due to eastward regional tilting. Production is found in the upper part of the reef, and recoveries are large because all producers are flowing wells. When depleted, they are flowing water wells. This complete flushing of an oil column originally as thick as 550 feet in many sectors is the reason for some of the fabulous producers. Three wells, Cerro Azul 4, Portrero del Llano 4, and Casiano 7, have produced more than 250 million barrels of oil.

POZA RICA: Poza Rica was discovered in 1930, and at this date the northwestern and southeastern limits are still undefined. During the period before expropriation (March 18, 1938), 14 producers in an area 6 miles long and three fourths mile wide were completed, from which about 50 million barrels of oil was produced. Since expropriation, an additional 91 wells have been drilled by Pemex and total accumulative production to January 1, 1950, was 365,841,005 barrels. At

the present time, there are 26 drilling wells of which eight are extension wells and can be classed as exploratory wells. During recent months the pool has been extended two miles southeast to add materially to the estimated reserves of more than 1.5 billion barrels. At the present time this pool is producing more than 110,000 barrels daily.

Pemex has surveyed the adjoining area with seismographs, and from the results of this work, the pool has been extended. The anticline on which Poza Rica is located has a west-northwest east-southeast axis. Only the northeast half of the anticline produces because the southwest half has



Surface geology of Tampico embayment. Modified from "Geology of the Tampico Region," by John M. Muir.

only dense non-porous limestones in the Tamabra (combination of the term Tamaulipas-dense limestone and El Abra porous reef limestone). Many theories have been advanced to explain this unusual character of the limestone. The most logical, in the writer's opinion, is that the porous zones in the Tamabra are clastic reef material deposited in an interbedded manner with the dense limestones. The clastic reef material was derived from the nearby prominent reef of the Golden Lane.

Production is found at from 7250-550 feet. Casing is usually cemented through the porous section or about the upper half of the Middle Cretaceous limestones, and perforated in the porous zones. Pemex has made elaborate studies of the field, and its production practices are most modern, employing the best engineering techniques. It is probable that this pool may become one of the outstanding oil fields in the western hemisphere.

MORALILLO: The fourth major field in the embayment area, Moralillo, is a comparatively recent discovery. Pemex, after surface and subsurface studies, drilled the discovery well in 1948. Since then 43 wells have been completed, and two are now drilling. To January 1, 1950, this pool had produced 1,107,006 barrels. The field is still being extended. Production is obtained from the Tamabra limestone, interbedded clastic reef and dense facies, at about 5300 feet. One of the unusual characteristics of this pool is the presence of an igneous plug almost exactly in the center of the producing area and of the anticline. Wells drilled near the igneous plug find porosity and produce oil which indicates the vertical shape of the plug and its lack of effect in indurating the sedimentary rocks surrounding the plug. New exploratory tests are to be drilled near some of the many other plugs in this area.

There is considerable discussion as to the relation of the igneous plug and the structure. The present thinking is that the structure was formed first, after which the igneous intrusions were injected into it. It is fairly well established that the igneous activity occurred in Oligocene time after the principal deformation occurred in this area.

Pemex has, with detailed surface, subsurface geologic studies and seismic exploration, developed many additional attractive prospects in the Tampico embayment. There are so many of these prospects that Pemex believes it must allow others to participate in the exploration. Sharples Corporation of Denver recently contracted to drill four exploratory wells in the embayment. This arrangement for drilling is along the lines that American Independent Oil Company, Signal Oil and Gas Company, and Edwin G. Pauley contracted for exploration in the Isthmus area. Other contractors are drilling or preparing to drill in the Golden Lane and Panuco-Ebano on a different type of contract with Pemex.

These additional exploratory wells plus the wildcat wells now proposed or drilling by Pemex will undoubtedly result in the discovery of new reserves in the Tampico Embayment. Such activity will continue to maintain this area as one of the outstanding oil provinces of North America.

The oil from the Panuco-Ebano field ranges from 9 to 18 gravity, and is in great demand as a source for the manufacture of asphalt products. All of this oil is moved by pipe line to Tampico, 20 miles eastward, and then exported. The oil from the Golden Lane ranges from 12 to 24 gravity and is shipped by pipe line to Tampico where most of it is refined, and the remainder exported. Oil from Poza Rica is more similar to Mid-Continent type crude and a large part is shipped by pipe line to refineries at Mexico City and Salamanca. Gas is also being transported by pipe line to Mexico City for industrial and domestic use. The gas is processed prior to shipment in a modern gasoline plant with 100 million cubic feet capacity. The different types of crude oils and the gas production in the Tampico embayment make the area an attractive oil province.

When compared to the older oil provinces in the U. S. such as Pennsylvania, West Virginia, eastern Kansas and Oklahoma, the Tampico embayment is robust and active with great possibilities of remaining one of the great suppliers of crude oil of all types to the world market.

BIBLIOGRAPHY

AAPG Bull. Vol. 33, No. 8, August, 1949.
World Oil, July 1, 15, September and October, 1950.
Muir, John M., "Geology of the Tampico Region, Mexico," AAPG Special Publication. 1936.
AAPG Bull. Vol. 34, No. 6, June, 1950, pp. 1260-1280.

About the Author

CLARK MILLISON, geological consultant to Petroleos Mexicanos, Mexican government oil monopoly, is well informed on Mexico. He was graduated from Columbia University in 1926 and obtained his M.S. from Oklahoma University in 1927. He was regional geologist for Shell Oil Company in Oklahoma and Kansas until 1937, when he resigned to engage in consulting work. Apart from his work in the Mid-Continent and Rocky Mountain areas, he has done consulting work in Peru, Panama, Cuba, Venezuela and Mexico.

First Pipe Received for Kirkuk to Banyas Line

Iraq Petroleum Company, Ltd., announced that the first shipment of 26-inch pipe to be used in the 32-, 30-, and 26-inch pipe line from the Kirkuk field to Banyas, Syria, has arrived at the port of Tripoli.

The pipe line will be 560 miles long and will require 145,000 tons of 32- and 30-inch pipe and 23,000 tons of 26-inch. The laying of the smaller pipe has already begun from Banyas to Homs Gap. The steep gradient permits gravity movement of the oil and the use of the small pipe. After completion of the line in 1953, IPC expects to deliver about 131 million barrels of oil annually to the Mediterranean for the markets of Western Europe. IPC presently has a 12- and a 16-inch pipe line in operation from the Kirkuk field.

The shipment of this pipe from the U. S. has brought protests upon the State and Commerce departments. Several U. S. oil and independent organizations contend that the pipe shipment was ill-advised in view of the tubular shortage now existing in this country. The State Department indicated that this large size pipe was not in short-supply at the present time and that all other equipment for the line was being obtained from sources outside the U. S. The political aspects of the shipment were raised when Jewish groups protested that the State Department was aiding in the Iraqi economic blockade of Israel.

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THE DOWNWARD HYDRAULICKING ACTION of the fluid through the baffled, side down-whirler ports of a Baker Whirler Shoe, and through the nozzle-like bottom outlet, effectively removes bridges and permits safe running of the casing.

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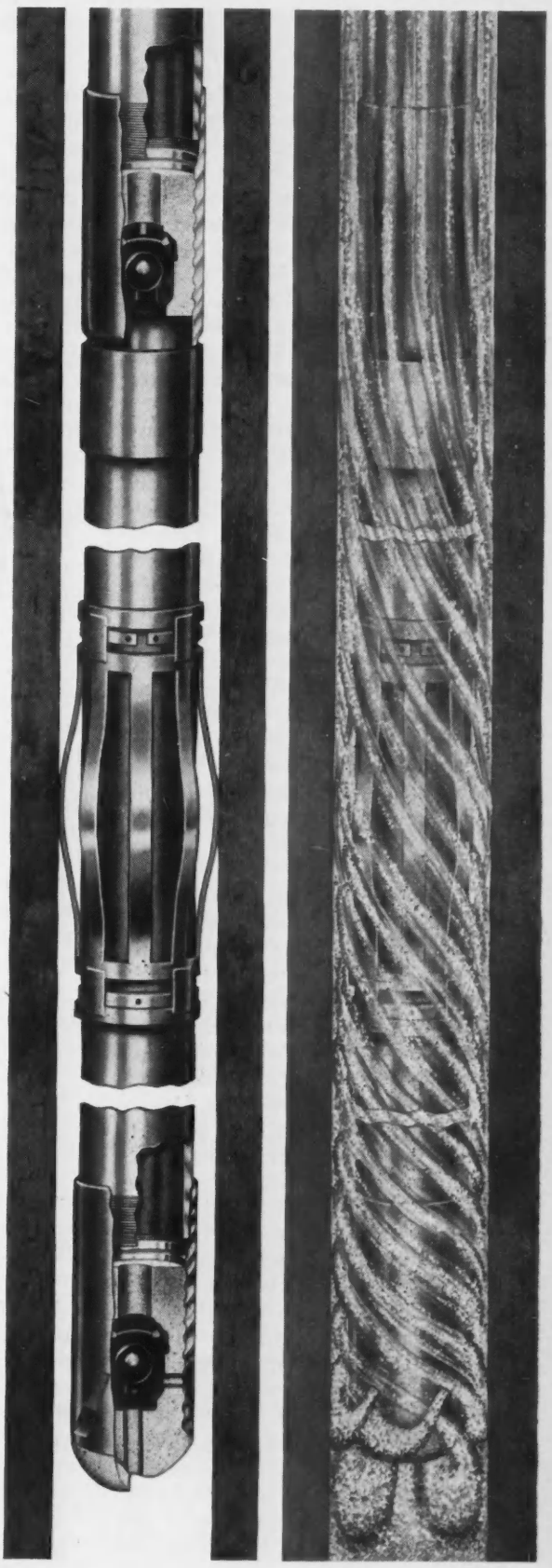

The view at far right shows the "whirling" motion given to the cement slurry as it is discharged from a Baker Cement Wash-Down WHIRLER Float Shoe, with the shoe joint centered by means of a Baker Model "G" Casing Centralizer. *This same whirling motion given to the circulating fluid, conditions and prepares the wall of the hole immediately prior to the discharge of the slurry.* The whirling action of the slurry, in turn, not only supplements the hole conditioning process, but also ensures that the centered casing will be completely encased with a uniform body of cement and that the hazard of channeling will be reduced to a minimum.

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KEY TO CEMENTING SUCCESS

Colombia Plans to Encourage Increased Foreign Oil Participation

By HENRY OZANNE
Eastern District Editor

REVISION of Colombia's petroleum legislation was announced in a series of executive decrees promulgated in Bogota November 14, and initial industry reaction was that the way may now be cleared for more active participation of American capital and skills in the development of Colombia's oil resources. The Colombia government's petroleum attache in the United States disclosed that the following changes had been effected:

● Three new reserve zones have been opened for exploration by private foreign oil companies. Previously, work could be carried on in these zones only after Colombian congressional approval. The need for such approval has been eliminated. These zones are (1) a large area comprising the departments of Vaupres, Vichada, Arauca and Notre de Santander, in the last named of which is located the Barco concession; (2) an area bordering Panama and lying between the Atrato River and the Pacific coast; (3) a strip 14 miles wide along the Pacific coast through the departments of Choco, Valle del Cauca, Cauca and Narino.

● Elimination of restriction of two concessions per company with limitation of size to 123,500 acres in the west and 494,000 acres in the east. This would obviate the necessity of a company creating an unwieldy number of subsidiaries for operating purposes. In 1948 there were 172 different oil companies registered in Colombia. The Texas Company was obliged to carry on work through 29 companies, and Tropical Oil had set up 27 units for its program. The new laws streamline corporate structure.

● Drilling obligations have been abolished. Under the previous law a three-year exploration period carried the requirement of drilling at least one well during the time. Henceforth, it is said, the exploration period will be five years and there will be no drilling obligation. If a company surrenders concession acreage, however, in the fourth or fifth year of its exploration period, it must submit geological data justifying the relinquishment.

● Surface rental fees have been modified in favor of the companies, ranging from about 5 cents to 25 cents a hectare (2.47 acres). First year rental fees are set at 10 cents, second year at 30 cents, third year at 50 cents, fourth year at 70 cents, and the fifth year at 90 cents. In the sixth year (first year of the renewal of an exploration permit) the surface rental drops to 60 cents, in the seventh year to 75 cents, in the eighth year to $1, in the ninth year to $1.25, and in the tenth year to $1.50. Further, these fees are reducible by 50 percent if a drilling rig is active on the concession.

● When the exploitation period begins, the hectare fee is to be reduced to half the surface fee of the year immediately preceding the start of pipe line shipments of crude oil.

● The boundary survey obligation which previously had to be completed in three years, is extended to six years.

The decree laws are expected to be validated by the Colombian congress at its next session early in 1951. Since the laws are promulgated by the Conservative party and the Liberal party has boycotted the forthcoming elections, a Conservative victory is assured and the new Conservative congress is expected to ratify automatically the decrees of its Conservative president.

Colombia's oil production has shown a sharp rise in 1950 over 1949. Output at the De Mares concession has climbed from 1,056.655 barrels for January, 1950, to 1,139,522 barrels for October this year; and Casabe production is up from 489,636 barrels a month to 925,124 for the same period. Colombia's total October production was 3,054,406 barrels, and the 1950 yearly total is expected to approach 34 million barrels.

The Colombian petroleum attache also said an agreement is imminent with International Petroleum Company (Standard Oil Company [N. J.] affiliate) by which International will operate for a fee the De Mares concession after the expiration of Tropical Oil's concession on August 25, 1951. The arrangement is said to provide for payment to International of 4 percent of production the first year, 3 percent the second year, and 2 percent for every year thereafter. Distribution will be handled by Esso Colombiana, S. A., the new marketing company which has taken over International's marketing assets. It is reported that the Colombian government is seeking an interest in Esso Colombiana.

The pending agreement with International is also said to provide for that company's operation of the Barrancabermeja refinery for a management fee of 20 percent of plant profits.

In connection with the latest developments in Colombian oil matters, a Tropical Oil Company (International Petroleum subsidiary) official announced that the Balsamo concession, now being contracted by them with the Colombian government, is one of a number of tracts under application on behalf of the company on which wildcatting is contemplated if preliminary exploratory work indicates favorable prospects. Tropical has previously indicated that it would not accept any partnership in a government controlled agency but would collaborate with the government in personnel training and administration should the government so desire. The decision not to participate as a partner with the government in De Mares did not mean the company ceased to be interested in Balsamo or any other application for concessions now pending with the government.

Liberalization of Colombia's oil laws is in accordance with recommendations made by a special International Bank for Reconstruction and Development mission which this year reported that the country's present proven oil reserves are "very limited" —less than ten years supply at current production rates. The mission reported "We believe it extremely important to encourage further intensive exploration by private oil companies which have the experience and resources necessary to undertake this highly speculative function. It is urgent, therefore, that the government clarify its relations with the oil companies without delay along the lines that will give encouragement to mutually advantageous exploratory work."

Spindletop

Given High Place in History of Industry

THE Spindletop story will be written indelibly into the history of the petroleum industry and of America this year through the Spindletop 50th anniversary celebration. Climax of the observance will be at Beaumont, Texas, on January 10, Spindletop's 50th birthday anniversary, as the field's discovery well, the famous Lucas gusher, a few miles south of Beaumont, blew in on January 10, 1901.

In addition, the elaborate celebration, staged on industry-wide and nation-wide scale, will include events before January 10 and on through 1951, commemorating the discovery and emphasizing its significance not only to the industry but to the nation.

The celebration fully merits the attention and support of all oil people, all business people, and all Americans. The Spindletop story is not just a tale of Texas. It is an epic of America, in which men of vision, courage, and resourcefulness made history for the American petroleum industry, the American industrial system, and the American way of life.

Finding of oil at Spindletop was a dramatic expression of American initiative under a free enterprise system. The discovery initiated large scale oil production in the Mid-Continent to offset decline of the older Appalachian fields, just as oil came into increasing demand through early development of the automobile.

To make the discovery, those responsible for it had to assume heavy financial risks, blaze a trail in petroleum geology, and pioneer a new (rotary) method of drilling. They demonstrated for the first time that salt domes mean oil. They showed that oil could be reached and produced, even if buried beneath loose, unconsolidated sands, if not by cable tools then by some other method of drilling, having initiated wide-scale use of the rotary method, which is now so essential for oil production. In developing the prolific field, the Spindletop operators put Texas on the oil map and started oil as an industry in the state, which became immediately one of the several leading producing states and eventually No. 1 in production and reserves.

The Spindletop discovery has been called the beginning of the modern petroleum industry. Previously, oil was produced almost exclusively from small wells and was used primarily in the form of kerosine, for illumination and to some extent for fuel. But then the industry changed into a supplier of gasoline for the gasoline buggy, and Spindletop ushered the industry into this broader and bigger field, showing that oil could be produced in large volume and that rich fields could be expected in Texas, Louisiana, and other parts of the Mid-Continent, as well as in the Eastern states and California. As rapidly as the automobile could be developed and made commonplace in America, the oil industry greatly broadened through the Spindletop discovery, likewise developed and expanded to meet the growing need for petroleum.

DISCOVERY OF OIL at Spindletop, near Beaumont, Texas, January 10, 1901, will be commemorated in a Spindletop 50th anniversary celebration. Promoted on an industry-wide and nation-wide scale, the celebration will reach a peak on January 10 at Beaumont but also will include events before and after that date. Spindletop provided the first large-output wells, initiated large-scale production for the Gulf Coast and Mid-Continent, and started widespread use of the rotary system of drilling.

There at Spindletop, with its unprecedented gushers, yielding unheard of volumes of oil, was American free enterprise in action. There was the American petroleum industry in an early, spectacular demonstration of the initiative and resourcefulness that were to characterize it through the years.

With free enterprise continuing as the American system, the American oil industry, having laid itself a firm foundation at Spindletop, went on to find and produce more and more oil, making it plentiful and cheap and thereby contributing greatly toward giving America the highest standard of living of any country on earth.

The Lucas gusher was generally estimated to have flowed at a rate of at least 100,000 barrels per day, approximately 16 times the volume of any previously known oil well. Its major significance arises out of the fact that, for the first time, American industry had reason to believe there was enough oil to permit its use as a commercial source of fuels and lubricants.

The Lucas discovery followed five failures to find oil at Spindletop. Its guiding spirits were Anthony F. Lucas and Patillo Higgins, neither of whom was a professional oil man. They were free-enterprisers of a history-making kind.

Various major oil companies, such as Gulf Oil Corporation, The Texas Company, Humble Oil & Refining Company, Magnolia Petroleum Com-

pany, and others were founded directly as a result of the discovery of Spindletop or else grew out of concerns that originated during the early Spindletop era. The producing, transporting, and refining departments of some companies then already existing, such as Sun Oil Company and Standard Oil Company, began with or were tremendously stimulated by this discovery.

Spindletop indicated the existence of other salt dome fields in Texas and Louisiana and so gave rise to Gulf Coast oil production, which has loomed large in the nation's supply. It led to the establishment and growth of the Beaumont-Port Arthur and Houston ports and made this section eventually the greatest oil refining center in the world, and placed Texas for the first time in a position of great prominence in the petroleum industry.

Spindletop and the ensuing discoveries on the Gulf Coast formed the background for the growth of a multitude of industries, and the discovery was a tremendously important element in the building of our current standards of living.

The Spindletop celebration is being staged under leadership of an official commission appointed by Governor Allan Shivers of Texas. The commission seeks as its primary objectives:

- To commemorate and record the significance of the Spindletop discovery and its relation to the industrial achievements which followed.
- To pay tribute to the individuals, groups, and corporate units for their part in the Spindletop discovery and subsequent important developments in the petroleum, natural gas, and petrochemical industries.
- To obtain by every available means widespread recognition of the importance of this vital contribution to the expansion and growth of these industries and to the general welfare of the nation.

The anniversary program has been designed to appeal to community interest, to the petroleum and allied industries, and to the U. S. public at large. It will embrace all the physical and emotional elements normally marshalled to commemorate an occasion of such historical importance.

Activities will continue throughout 1951, but the focal point will be the ceremonies planned for Beaumont during the week immediately preceding and particularly on January 10, which is the actual 50th anniversary of the Spindletop discovery.

The culmination of the many preliminary events leading up to this main observance will be an evening program where the whole impact of the Spindletop discovery on modern civilization will be crystallized in a

Members of the Spindletop 50th Anniversary Commission

JUSTICE LEACH MYERS BETTS NEWTON

Left to right: Phil S. Justice, vice chairman, manager of Land department and member of Management Committee of Sun Oil Company, Beaumont. W. W. Leach, secretary, assistant manager of the Refining division of Magnolia Petroleum Company, Beaumont. Scott W. Myers, vice chairman, independent oil operator, Beaumont. I. F. Betts, treasurer, president of American National Bank, Beaumont. John W. Newton, chairman, vice president and manager of Refining division of Magnolia Petroleum Company, Beaumont.

ROBINSON WALLACE BROCK COOPER McAFEE

Left to right: Spencer W. Robinson, executive director, Houston. F. L. Wallace, member, works manager of The Texas Company, Port Arthur. Marion E. Brock, member, assistant to vice president of Gulf Oil Corporation, Houston. C. W. Cooper, member, manager of The Pure Oil Company, Nederland. Dr. A. M. McAfee, member, chairman of the board of regents, Lamar State College of Technology at Beaumont, Port Arthur.

series of speeches. These will be given before a specially invited audience to include, among others, representative leaders throughout the nation from the petroleum and allied interests, industrial organizations, the military and other governmental agencies, and community groups. Speakers and guests will be drawn from the top leadership of those industries and branches of the government most closely associated with, or benefactors of, the modern petroleum industry. These will include men from such industries as automotive, aviation, railroad, marine transportation, steel, chemical, and petroleum, from the military, and from government bureaus.

At least four major petroleum industry conventions have been arranged for Beaumont during 1951, and full cooperation will be extended to these and all other groups by supplying background material and speakers that will serve to further develop the Spindletop story within the ranks of the industry itself. Conventions that have been arranged include: American Petroleum Institute, spring production meeting, Southwestern Division; Texas Independent Producers and Royalty Owners; National Oil Scouts and Landmen's Association; and Texas Mid-Continent Oil and Gas Association.

In addition to these efforts, and supplemental to the whole program will be an educational and historical exhibit based on the theme of "then and now." To be maintained intact throughout 1951, the exhibit will include historical documents, photographs, graphic panels, dioramas, and as many examples as available of original tools, equipment, methods, and processes developed by the industry to be displayed against a background of photographic murals of their present-day counterparts.

If justified by historical data collected and exhibits developed, consideration will be given at the close of the observance to establishment of a permanent "Spindletop Historical Petroleum Museum" to preserve and perpetuate the history and accomplishments of the petroleum industry.

A contest was conducted to develop an appropriate slogan for the occasion and to create preliminary public interest in the importance of the Spindletop discovery. Selected from among 4000 entries, the winning slogan was "Spindletop . . . Where Oil Became An Industry." Judges felt it appropriately dramatized the unique position occupied by Spindletop in the realm of oil. The slogan is being used with all literature and promotional material publicizing the observance program.

Since the main objective of the program is to foster better understanding on the part of the industry and the general public of the Spindletop epoch and its relation to the nation's industrial progress, wide advertising of the event is being promoted. Cooperation has been obtained from oil companies in their national advertising programs, from railroads, airlines and other transportation agencies, from petroleum equipment suppliers in their trade advertising, and from oil, chemical, and related industries in their national radio shows.

The program is being financed through voluntary contributions from companies and individuals that have wanted to be identified in this way with the primary objectives sought. Due to the non-profit and educational status of the organization for staging the celebration, it is anticipated that all contributions will qualify for deductions under federal income and other tax provisions. Any surplus funds contributed will be used for educational endowments.

The Story of the Lucas Gusher Monument

A TOWERING shaft of granite 58 feet high, the Lucas Gusher Monument stands on the site of the famous well that discovered oil at Spindletop, January 10, 1901. The impressive monument, honoring the Lucas well and the Spindletop pioneers, was dedicated October 9, 1941, during the annual meeting of the Texas Mid-Continent Oil and Gas Association at Beaumont.

The monument was financed and erected by the Lucas Gusher Monument Association, which was organized and incorporated July 9, 1940, by J. Cooke Wilson, president; Stephen W. Pipkin, vice president; Scott W. Myers, secretary; and Marion E. Brock, treasurer. The cost of the monument was borne by some of the companies, old timers, and operators, most of whom got their start in the oil business at Spindletop.

Building of the monument was the fulfillment of a hope that had been entertained by a few men for as long as 20 years previously. The inspiration for building the monument arose in 1920 during a meeting of the operators at Spindletop on a waste disposal matter. After the meeting and during an informal discussion, Brock asked about exact location of the Lucas Gusher, and out of a group of 10 or 12 operators, there were only two with actual knowledge of its location. It was the general sentiment of those present that a permanent marker should be placed over this historic well.

Brock, who is now assistant to the vice president of Gulf Oil Corporation at Houston, lived at that time in Beaumont and was a member of the board of directors of the Beaumont Chamber of Commerce. He proposed to the directors that they sponsor the project. But this effort was unsuccessful, and there was no action on the matter until the organization of the Lucas Gusher Monument Association.

Spindletop

First and Among Best of Gulf Coast Fields

By L. J. LOGAN
Associate Editor

DISCOVERED 50 YEARS AGO, Spindletop field, near Beaumont, Texas, not only ushered in a new era in the history of the American oil industry but also entered upon a remarkable individual field history, in which it has proved to be among the best fields of the Gulf Coast and of the U. S. Opened January 10, 1901, by a wonder well, the Lucas Gusher, and revived after a quarter of a century with prolific deeper production in 1925, Spindletop now has produced over 131 million barrels.

SPINDLETOP was the first and has been one of the most prolific of the many oil fields of the Gulf Coast. It was discovered January 10, 1901, by the Lucas gusher, which spouted a six-inch stream of oil 200 feet into the air, producing an estimated 100,000 barrels per day.

That was 41 years after the U. S. oil industry started with the Drake well in Pennsylvania. Oil was being produced in substantial amounts in the Appalachian and Mid-Western States and California and to some extent in Oklahoma, Kansas, Texas, and the Rocky Mountains. But that production was from small wells. There was no precedent in oil history for the tremendous gas pressure and volume of oil found at Spindletop.

The famous well brought an immediate influx of 50,000 people into Beaumont, population 9000. Overnight, it made Texas one of the leading oil producing states and initiated large scale oil development not only for Texas but also for the whole Gulf Coast and Mid-Continent. A year later there were 138 producing wells at Spindletop, and in 1902 the field's reported production was 17,420,949 barrels, an average of 47,729 barrels per day.

Subsequently, output declined sharply, with wells produced to capacity, and by 1924 it averaged only about 1000 barrels per day. In 1925 Spindletop was spectacularly revived through discovery of large new, deeper production from the flanks of the dome, the earlier production having been from caprock on top of the dome at depths of 900 to 1200 feet.

The Lucas Gusher, Spindletop discovery well, became famous immediately when it blew in January 10, 1901, and ran wild, for there was no precedent in oil history for its tremendous gas pressure and the large volume of oil it produced. This picture, itself now famous, many thousands of prints of it having been sold, was taken during the nine days when the well flowed, uncontrolled. It confirms the reports that the Lucas well shot a 6-inch stream of oil at least 200 feet into the air. (Reports have stated that the derrick was 80 feet high.) Experienced oil men estimated the production at 75,000 to 100,000 barrels per day. The well spouted an estimated 800,000 barrels of oil onto the surrounding land, forming an oil lake covering about 100 acres. The "lake" later caught fire, and all the oil was lost. The well itself did not burn, as it already had been capped and covered with a mound of earth, after having run wild for nine days.

In the second boom, Spindletop production reached a peak of 20,751,000 barrels in 1927, an average of 56,852 barrels per day. Again production declined, and in a recent month the field had 163 wells, of which 11 flowed and 152 were pumping, with a combined output of 1600 barrels per day, or about ten barrels daily per well.

As Spindletop approaches its 50th birthday anniversary, it is credited with a total recorded production of approximately 131 million barrels, being one of the leading fields of the Gulf Coast in cumulative output, surpassed by only a few newer fields, on much larger structures, including Conroe and Hastings. From the standpoint of recovery per acre, Spindletop has a remarkable record. The 131 million barrels of production has come from a productive area of only approximately 500 acres, indicating actual recovery so far of over 262,000 barrels per acre.

The Gulf Coast and California lead the country in high recoveries per acre. The Spindletop record is the best for any Gulf Coast field, with the next best field of the district, West Columbia, showing about 150,000 barrels per acre.

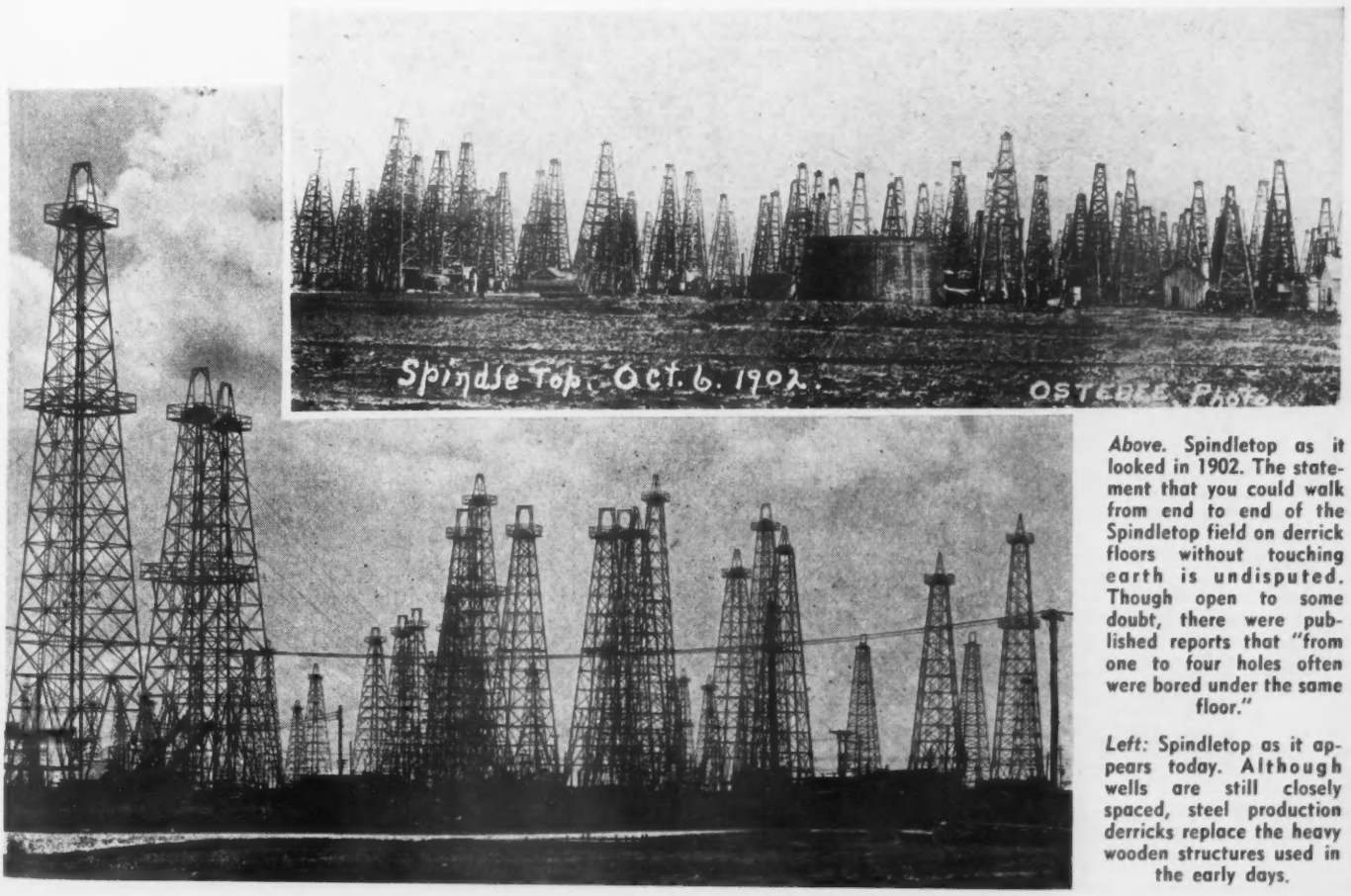
Having large thicknesses of sand and multiple sands, the Long Beach and Santa Fe Springs fields of the Los Angeles Basin, California, have surpassed Spindletop in recovery per acre, showing about 525,000 and 360,000 barrels per acre, respectively. But Spindletop outranks such other outstanding California fields as Inglewood, with nearly 200,000 barrels per acre, and Ventura Avenue, with about 150,000 per acre.

Derivation of Name

There are conflicting explanations of the derivation of the name of the Spindletop field. According to one account, the name was taken from a so-called island of timber, located on the northeast corner of the John A. Veatch survey, near the dome. The contour of the timber resembled an inverted spindletop when viewed from the surrounding prairie, according to this explanation, given in the book, "Geology of Salt Dome Oil Fields," by DeGolyer and others. It is said, according to another explanation, that the word Spindletop first referred to an inverted cone-shaped tree on a bluff near the turning basin on the Neches river east of Beaumont, near the site of the oil field. The term was first used, according to this story, by crews on rice and lumber boats.

The oil history of Spindletop began about 1890, when Patillo Higgins of Beaumont undertook to find oil, based on indications in the form of gas seeps and the 15- or 20-foot elevation of the area above the prairie. He laid out a section called Gladys City, and in 1892 formed the Gladys City Oil Company. Several water wells dug to 15 to 20 feet yielded sulfur water. First oil tests were drilled in 1893. W. B. Sharp and J. S. Cullinan drilled with a small rotary to 418 feet, passing up a gas sand at 60 feet. Higgins completed a small gas well in that 60-foot sand and used the gas to fire a boiler. Savage Brothers and Looney et al. drilled other tests at about the same time.

Captain Anthony F. Lucas, a mining engineer, went to Beaumont in 1900. Having engaged in salt mining in southern Louisiana, he believed that sulfur, oil, and gas as well as salt were associated with the domeline mounds on the Gulf Coast, such as that at Spindletop. Financed by Guffey and Galey, Pennsylvania oil men, Lucas drilled his No. 1 well and recovered some oil before losing the well at 575 feet. In October, 1900, he started his second well a little southwest of the apex of the dome, having let a drilling contract to the Hamill brothers of Corsicana. Using a rotary rig that employed designing and techniques developed by Lucas, they successfully penetrated caving sands that had stopped earlier tests, and at 1139



Above. Spindletop as it looked in 1902. The statement that you could walk from end to end of the Spindletop field on derrick floors without touching earth is undisputed. Though open to some doubt, there were published reports that "from one to four holes often were bored under the same floor."

Left: Spindletop as it appears today. Although wells are still closely spaced, steel production derricks replace the heavy wooden structures used in the early days.

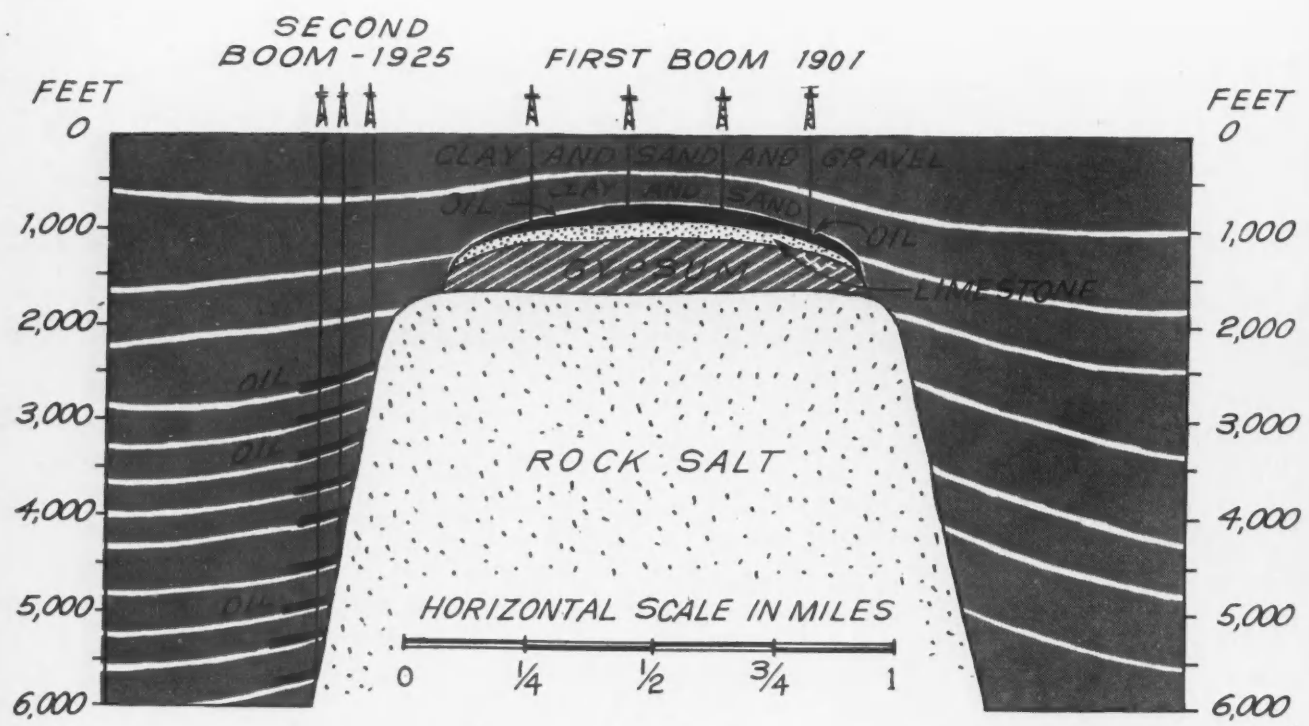
feet the well blew in unexpectedly. This was the famous Lucas gusher. It ran wild and made a lake of oil that later caught fire from a passing locomotive and went up in flames, but the well itself was capped and covered with a mound of earth.

Patillo Higgins and associates, through Gladys City Oil Company, held 2200 acres of 20-year leases on the dome. They employed Captain Lucas to manage drilling on the leases but soon changed the name of the company to Gladys City Oil & Gas & Manufacturing Company, and subleased the acreage, became strictly a royalty company. There was much trading and subdividing of this and other acreage, and the field was very closely drilled, with many derricks virtually touching each other. The boom was in full swing at the middle of 1901, and drilling and production reached the peak of this original Spindletop boom in 1902. Besides recorded production, millions of barrels were lost through waste and fires, with output exceeding handling and storage facilities. Output in 1903 was only half as great as in 1902, and each of the next several years brought further sharp declines, after which the decrease was gradual. Production finally held at around 1000 barrels daily until the second boom started in 1925. That revival occurred after several other salt dome fields yielded oil from deeper sands around their flanks, leading the way for similar production on the flanks of Spindletop.

Spindletop is a typical Gulf Coast piercement type salt dome. The cylindrical rock salt core, about a mile in diameter and flat on top, lies about 1700 feet beneath the surface, and is topped by about 600 feet of anhydrite-gypsum, above which is around 200 feet of limestone (dolomite). It was in the upper part of that porous, cavernous limestone, at depths of 800 to 1200 feet below the ground, that the remarkable accumulation of oil was found. The oil was sealed in the top of the caprock by overlying impervious clay and sand and gravel. Resting on top of the salt mass but not wholly covering it, the caprock was within a circular area less than a mile in diameter, and was productive only in parts of that circle, with barren areas separating productive areas.

After Spindletop proved the great possibilities of oil on Gulf Coast salt domes, leasing and drilling spread to other known domes and soon some of them were producing. Not far away, at Sour Lake in Hardin County, Texas, and at Jennings, Acadia Parish, Louisiana, production began in 1902; in 1903 it started at Batson; 1904 brought oil at Saratoga and in Matagorda County, Texas; and 1905 ushered in Humble and Dayton. Later years brought other discoveries, and by the early 1920s there were around 20 producing fields on the Gulf Coast. However, most of the shallower salt domes had then been found and tested, and with older fields declining, operators sought and began to find oil in deeper sands flanking the domes that had produced or failed to produce from the caprock.

In such exploration, Yount-Lee Oil Company discovered flush oil production at 2518 feet in a well on the southeast side of Spindletop on November 16, 1925, and soon afterward completed Gladys City 3 to the southwest of the old field at 3150 feet. Drilled almost exactly a quarter century after the Lucas gusher, these wells started Spindletop on its second boom and second period of major production, which now has lasted another quarter of a century. In the flank development, good wells were completed at depths to around 5800 feet. As previously noted, peak production of the second period was somewhat greater than that in the first quarter century. Also, total production in the second quarter century has greatly exceeded that in the first 25 years. Whereas Spindletop had recorded production of approximately 49 million barrels in the 25 years, 1901-1925, it produced approximately 82 million barrels in the 25 years, 1926-1950.



In its first quarter-century, 1901-1925, Spindletop produced 49 million barrels from cap rock at shallow depths. Then its second quarter-century, 1926-1950, it produced 82 million barrels, mostly from lateral sands along the flanks of the salt dome, at depths of 2500 to 5800 feet.

When the famous LUCAS GUSHER blew in... S. M. JONES was there!

One of the first supply stores in Beaumont, which had been opened by S. M. Jones, President of the Acme Sucker Rod Co. early in 1900, was humming with activity on that momentous morning of Jan. 10, 1901.

In the words of Mr. A. W. Hamill, the driller on the well: "While we were having breakfast (at the house of Mr. Lucas) the first oil men arrived at his house on the way to see the well. They were J. S. Cullinan, S. M. (Golden Rule) Jones and T. J. Wood."

Pioneers in the supply business, having also opened the first oil well supply store in the State of Texas area at Corsicana, Texas in 1897, Jones has since pioneered practically every major advance in the development and use of sucker rods. When you specify Jones Sucker Rods you get the best.

Today, Jones sucker rods are a familiar sight in most fields where they are depended upon for outstanding service under all conditions—in wells of all depths.

THE S. M. JONES COMPANY *Division of Buffalo-Eclipse Corporation*
General Office and Factory: TOLEDO, OHIO
SALES OFFICE: Kennedy Building, Tulsa, Okla.
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LOOK FOR THE GREEN RODS!

JONES

SUCKER RODS

Best in the Field

Spindletop's Production Peaks: 1902 and 1927

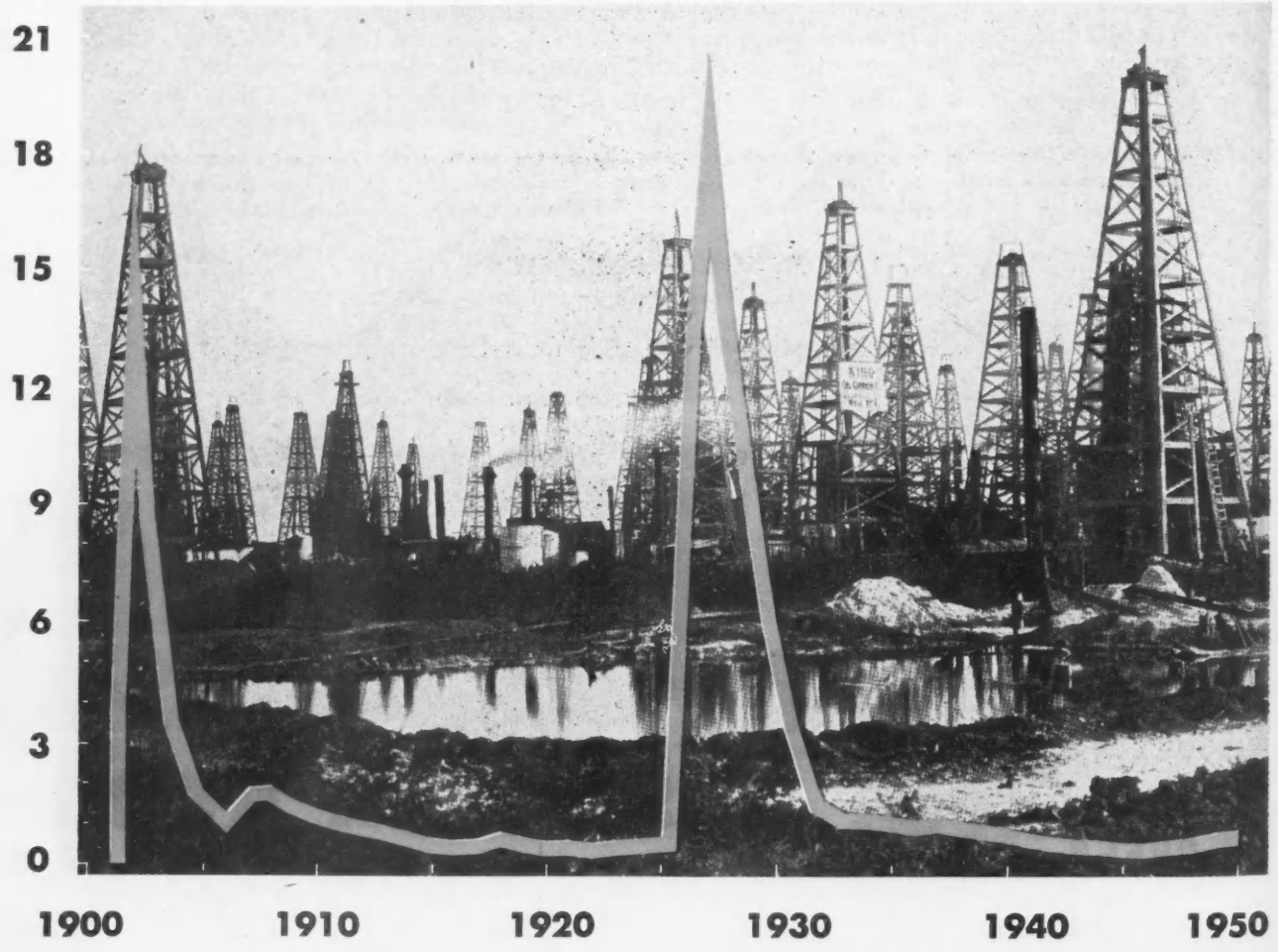
DISCOVERY of oil at Spindletop in 1901 was not the first for Texas, but it was the first of importance and is generally regarded as the beginning of the state's great industry. While this discovery was putting Texas on the map with other important oil-producing states, it was also regaining for the U. S. the top position among oil-producing countries, which had been taken over by Russia several years before. Russia had surpassed the U. S.'s output in 1898, and continued to do so until 1902 when the full impact of Captain Lucas' Spindletop strike was felt. Since that time no country has been able to challenge the U. S. position as the No. 1 oil-producing nation.

Spindletop, in 1902, the first full year after its discovery, gave up almost 17½ million barrels to account for more than 96 percent of Texas' total oil production, and nearly 10 percent of the entire world's output.

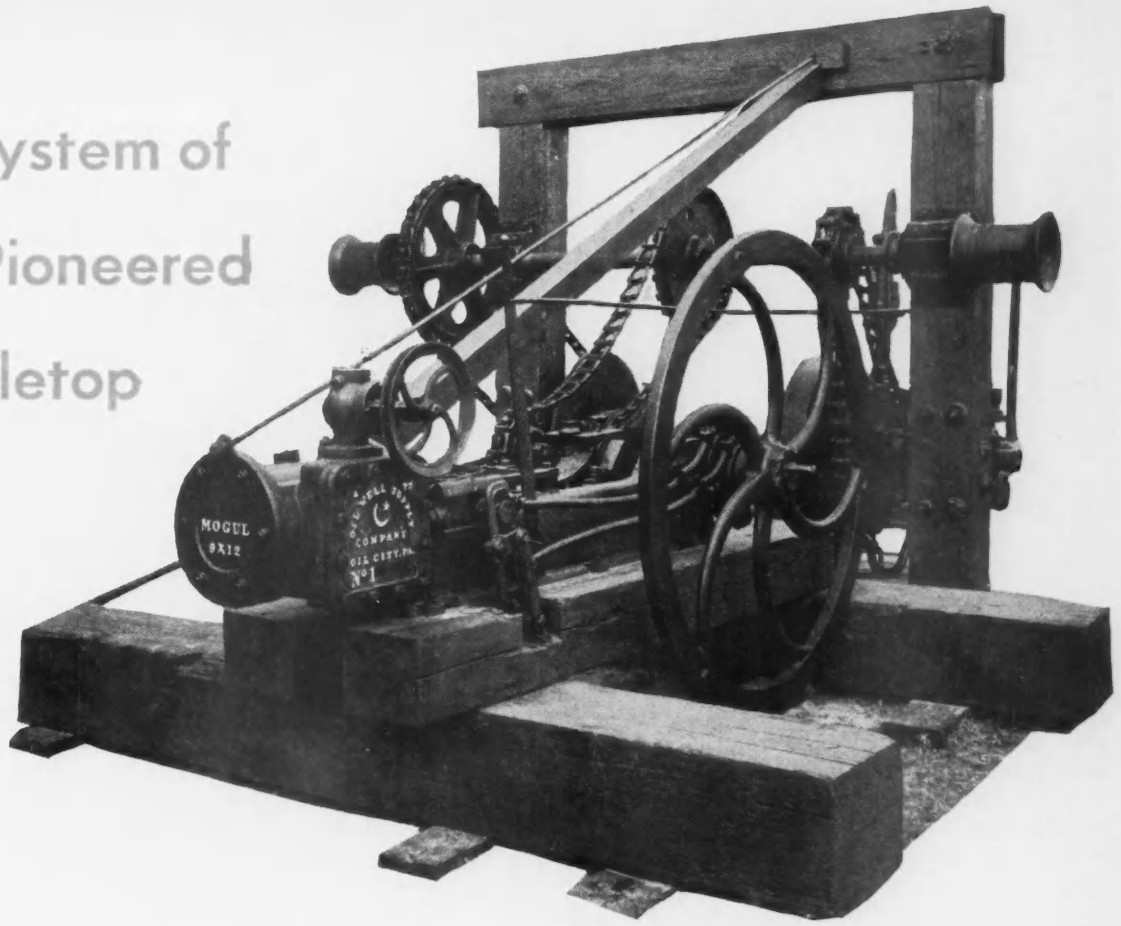
This great old field reached its peak in 1902, when output was more than 17 million barrels, and production dropped rapidly until 1915 when it stabilized at an average of slightly under 400,000 barrels a year. For ten years more it plugged along; then in 1925 a new deeper sand was found to be holding flush production and old Spindletop was off again. That time, a new peak was hit in 1927, the second full year after the new discovery, and that time it amounted to 20,751,000 barrels. Rapidly and then gradually production subsided until at present it totals slightly less than ½ million barrels annually. To date, the field has contributed almost 131 million barrels and rightfully deserves a ranking along with the best on the Gulf Coast.

Spindletop Production, 1901-1950

(FIGURES IN MILLIONS OF BARRELS)



Rotary System of Drilling Pioneered At Spindletop



Fifteen horsepower engine manufactured in 1912 (rated at 175 revolutions per minute), still preserved today, connected in the conventional manner to an early drawworks. This engine weighs about 3300 pounds complete, and cost $360. Drawworks cost little more than $200.

By J. E. KASTROP
Gulf Coast District Editor

AMONG THE MANY important achievements for which Spindletop is significant, one particularly worthy of tribute was the accelerated use of the now highly-successful rotary method of drilling. It was at Spindletop that many improvements in equipment and procedure were made that left their mark on modern rigs. This historical account of the rotary system is far from a complete treatment of the subject, and is intended only to record the beginnings of a mighty industry.

THE multi-billion dollar petroleum industry owes much of its bigness to the rotary system of well drilling. Although this method of making hole first found popular use in water well drilling and in boring the relatively shallow oil wells at Corsicana, Texas, in the late 1890s, it was the discovery of prolific Spindletop in January, 1901, by the famous Lucas gusher that brought the rotary system into widespread prominence.

The records do not clearly show who had the vision to bring the rotary to Spindletop. Was it J. M. Guffey of Guffey & Galey, Pittsburgh oilmen who financed the Lucas gusher, who wrote the Hamill brothers of Corsicana in August, 1900, that Captain Lucas would visit them for a drilling contract discussion? Or was it Lucas himself, a mining engineer and experienced geologist of no small talent, who recognized the difficulty he had on his first Spindletop well, where quicksand all but broke him, and saw a solution in the "hydraulic" principle?

Perhaps a turn of fate brought the rotary to Beaumont, since the Hamill brothers were only one of many water well drilling contractors at that time,

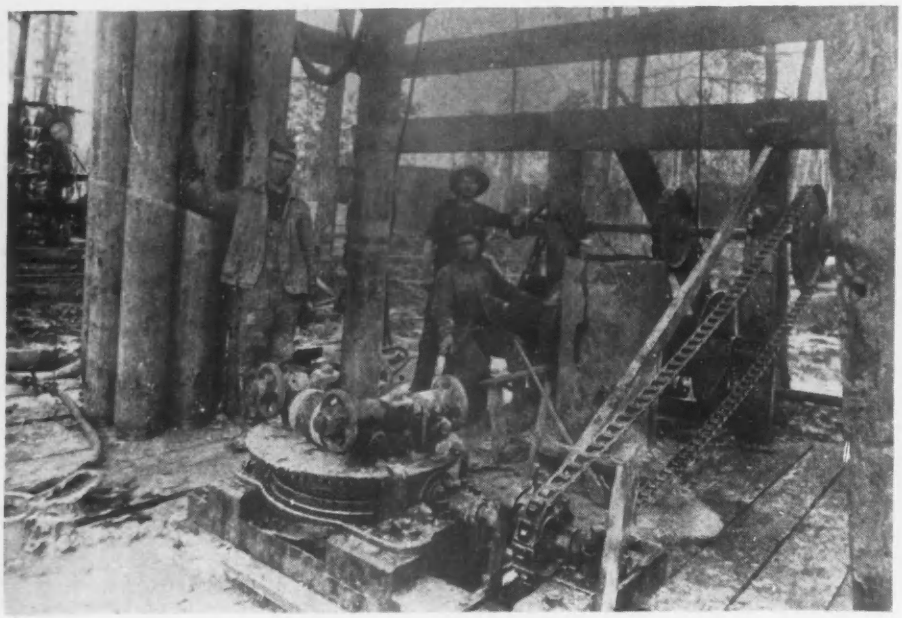


FIGURE 1. Drillers of more than 45 years ago had few of the modern and efficient tools found on the 1951 drilling rig. Taken at Sour Lake in 1905, this is a typical derrick floor scene of that day.

when both cable tools and rotaries were in use. It was no accident, however, that they specialized in this relatively new method of drilling oil wells in the Corsicana field. It had been known for some time that the rotary rig was more effective in this oil field, discovered in June, 1895, by an intended water well drilled with a small rotary rig.

That individual who did see a possible solution to the quicksand barrier that thwarted five attempts on the Spindletop dome prior to the Lucas discovery should be acclaimed by all now engaged in the industry. Not only were other methods of drilling unsuccessful in penetrating the unconsolidated formations near Beaumont prior to the Spindletop gusher, but every conceivable type of boring machine brought from Austria, Canada and Pennsylvania into Spindletop after the boom started also met with failure. It can be duly stated, then, that Spindletop was the cradle of the modern rotary system, which has made possible drilling wells to depths undreamed of by the industry's founders.

Fundamental Principle Unchanged

A study of the equipment and methods used by rotary contractors in the early 1900s reveals a prominent fact: that the fundamental principle of rotary drilling as employed more than 50 years ago was exactly the same as it is known and used today. John J. Conry,[1] former president of The Carter Oil Company, wrote in 1941: "Even a casual backward glance over the past 25 years in oil well drilling recalls two conflicting situations. One is the striking contributions of the scientist and the engineer to remarkable improvements in drilling equipment and methods. The other is the unmistakable fact that fundamentally methods have not been changed, merely refined."

It is more difficult to trace the very beginning of the hydraulic principle, as it was known in the early days, than to trace the refinements in the rotary method since the days of Spindletop. The history of the rotary system prior to Corsicana contains conflicts. Dr. J. V. Pennington[2] credits Leschot, a French civil engineer, with first using true rotary drilling with a diamond bit in 1863. However, Conry[1] reported his belief that the principle possibly had its origin 38 years before Colonel Drake drilled his history-making well at Titusville, Penn., in 1859. The early driller was also a Frenchman, P. Phanor Prudhomme, who in 1821 employed the rotary principle along with percussion methods, in an attempt to drill a water well at Bermuda, Natchitoches Parish, Louisiana. Prudhomme's crude tools were hand-forged by a Negro slave. Prudhomme 1 was abandoned at 400 feet when hard rock was encountered, but the drill stem and bits used are preserved today in Natchitoches. It is somewhat strange to find these early tools not so different in principle from some of the tools found around modern rotary rigs. The log of this well was also preserved.

Perhaps the earliest and most complete description of the rotary principle of drilling is contained in U. S. Patent 443,069 which was filed in 1887 by Chapman. This was undoubtedly the first reference on file where the use of clay or gumbo was suggested as a means to wall up the hole, and he even suggested the use of bran, rice, grain cement or other plastic and adhesive materials. This could well be the prelude to the present drilling mud industry.

In an early catalog[3] of oil field equipment, an early use of mud is

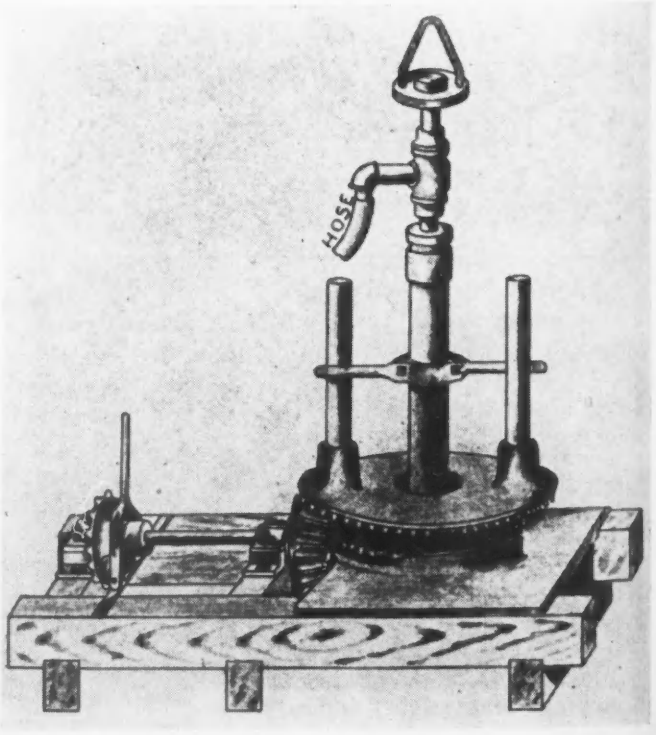


FIGURE 2. This is an early type of rotary, used up to about 1899 in drilling shallow water wells. Some of these units were used in the Corsicana field before 1900.

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described. About 1889, B. Andrews, Sr., of New Orleans, water well drilling contractor employing rotary rigs, was credited with discovering that thick plastic mud thoroughly mixed with water would wall up the hole. He also found that by using a mud-laden fluid, a well could be completed with only one string of casing which was run in the hole after it was drilled to total depth. Figure 2 shows a drawing of a rotary used up to about 1899 for drilling water wells and for shallow oil wells in the Corsicana field, where drilling was quite easy. From this simple drawing, taken from an early catalog,[3] it can be seen that the elements of the rotary method were in full use prior to 1900.

The Baker Rotary

C. A. Warner[4] writes that the Baker rotary method of drilling was originated in about 1883 in the territory of Dakota where M. C. Baker and his brother, C. E. Baker, used it for drilling water wells. The *Beaumont Journal* published an interview June 22, 1901, with M. C. Baker wherein he stated that he was one of the discoverers of the rotary method of drilling and had operated it in Louisiana, Texas, Dakota, Minnesota and Iowa for about 16 years. He claimed to be the first user of the first rotary rig ever made and had invented the "jetty system" of removing dirt from holes.

The early Baker rotary system, according to Warner, had no pumps to circulate the water used as drilling fluid. In order to establish circulation, water was poured into the drill stem from an elevated platform and the cuttings were washed out the annulus. It later developed that while drilling near a windmill, the discharge from the windmill was connected to the drill pipe and the platform was eliminated. This, probably, was the forerunner of the mud pumps which soon thereafter were adapted to circulate the fluid and furnish far more pressure than could be achieved by the primative gravity system first used. This was the simple outfit developed in the Dakota territory by the Baker brothers, who were early arrivals at Corsicana when the drilling boom was on. Records show that in 1898 a total of 374 wells were completed at Corsicana. Here, with the aid of H. G. Johnston, Elmer Akins and Charles Rittersbacher, the Baker brothers developed a more efficient rotary rig which is a predecessor of the modern rig.

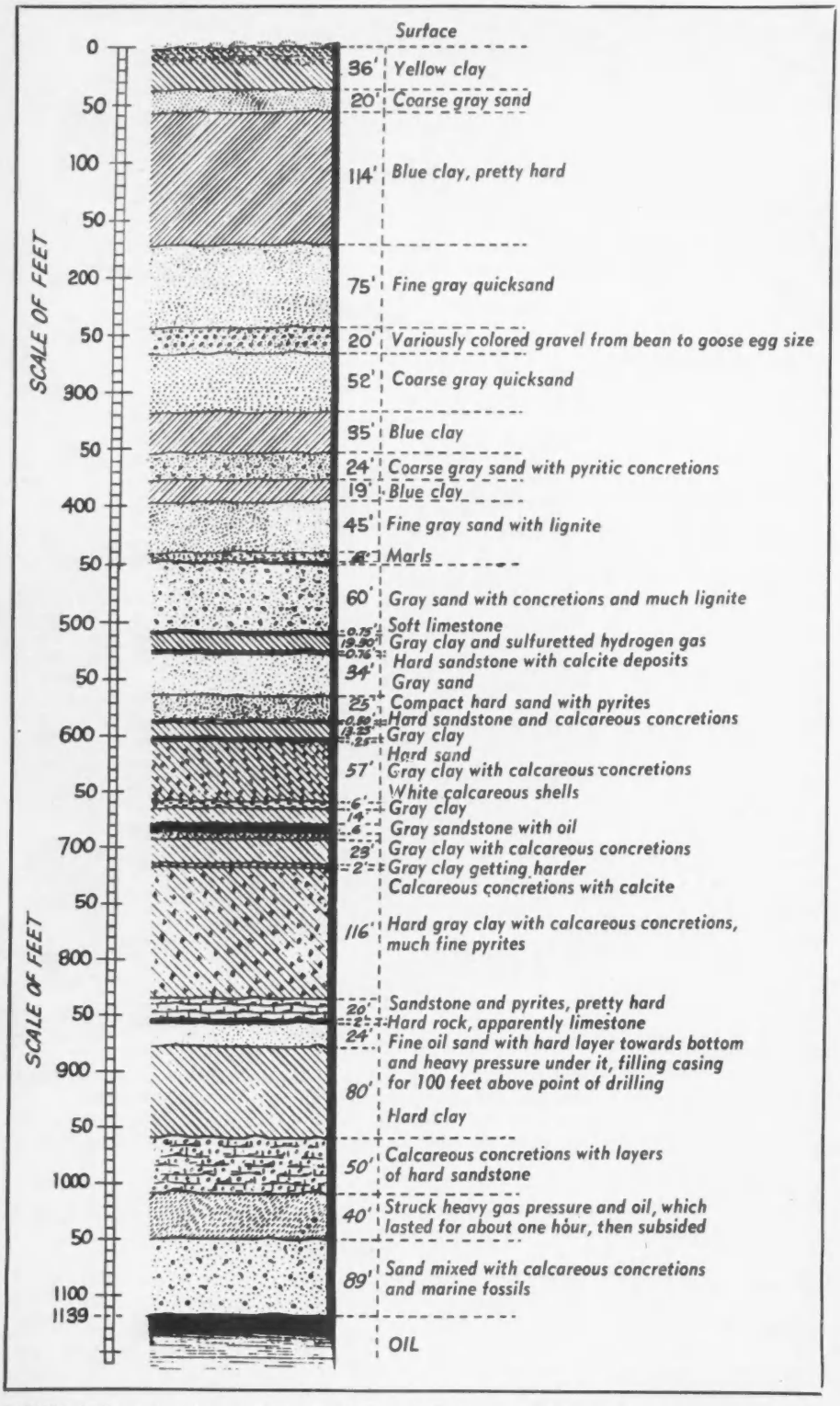
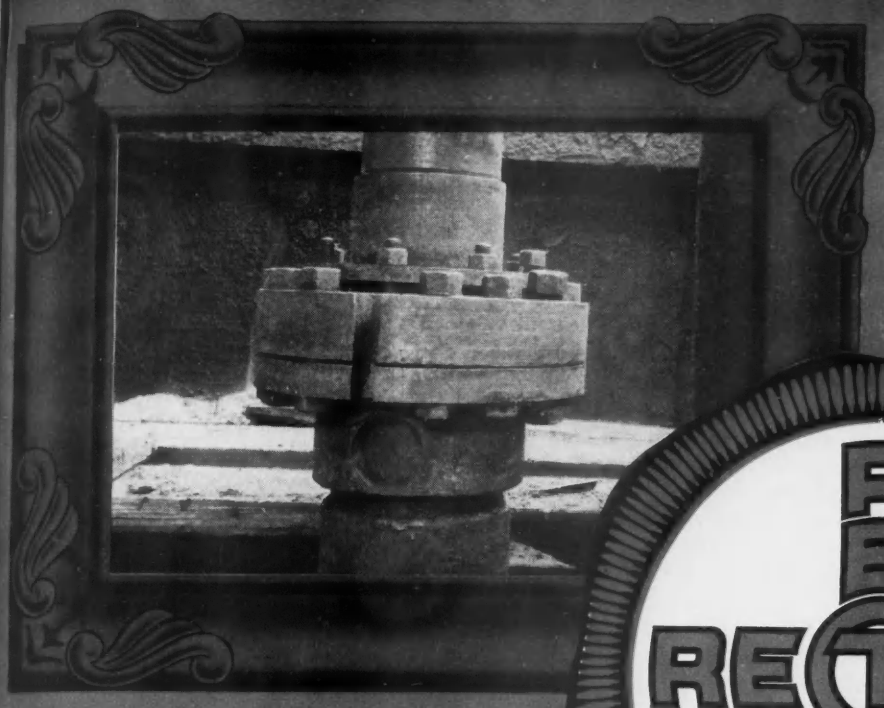


FIGURE 3. Geological log of the Lucas Gusher. It is interesting to note the exacting description given each section, in language not too different from that used today. Undoubtedly Captain Lucas, a mining engineer and geologist, made this log himself.

Early Equipment

Early 1900 derricks, about 60 feet in height, were of wood; the derrick floor rested upon heavy timber placed upon the ground; and many pieces of equipment not entirely made of steel were mounted on heavy oak bases. Main reinforcing members in the early drawworks were of wood, as was the framework for the rotary and crown blocks. Much of the equipment found on these early rotary rigs was taken en toto from other industries, or consisted of replicas of equipment used elsewhere with slight modifications, save one. This one distinguished original piece of equipment was the rotary itself.

The principal means of power at the turn of the century was steam, and it was only logical that those early rigs were driven by steam engines available at that time. The boiler most suited for this field work was the locomotive type, which con-



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tinues in popularity today. Drawworks were somewhat crude hoists, patterned after lifting devices of that day, but modified to suit the needs of drilling wells. There was nothing new, of course, in blocks and pulleys. Well or creek water, wherever it could be found, was used as the drilling fluid until the late 1890s. Fuel for boilers was, in most cases, cord wood obtained from a nearby lumber mill or chopped by hand in the vicinity of the well.

Undoubtedly, regular manila rope was first used by the early water well drillers employing the crude rotary rigs; however, standard hoisting cable made of crucible cast steel was introduced at an early date. By 1907, hoisting cable from one-fourth inch up to 2¾ inches in diameter was available. Drilling lines of 1⅛-inch, 6 x 19 construction, were rated for only 16,800 pounds load and cost just 38 cents per foot.

The Hamill Rig

When a drilling contract was signed by Captain Lucas and the Hamill brothers of Corsicana to drill what turned out to be the Spindletop discovery well, a price of $2 per foot for a 1200-foot test was agreed upon. The rotary equipment, less the derrick, was loaded on railroad cars and shipped to Beaumont. Major items of equipment consisted of one 25-horsepower locomotive-type boiler, two 8 x 5 x 10-inch Smithvale circulating pumps, an American Well Works rotary and drawworks, and an Oil Well Supply Company steam engine. By the time the Lucas well was drilled, surface pipe was in vogue and 20 feet of ten-inch pipe was set. Figure 3 is a reproduction of the log made on the Lucas gusher, undoubtedly by Captain Lucas himself, judging by the geological terminology used.

At the end of the first year following the Lucas gusher, 138 wells had been drilled at Spindletop. Up to 1907, a total of 4726 oil wells were drilled in Texas and Louisiana by the rotary method. In that year, 1907, about 175 complete rotary rigs were in operation. This accelerated use of the rotary brought about a new manufacturing market for equipment suppliers, and several large concerns were making and selling equipment for rotary rigs.

Early drill stems were driven by a crude device that permitted only a few feet of hole to be dug continuously. This system, shown in Figure 2, consisted of a pipe clamp equipped with wing extensions that bolted to the drill pipe. The clamp extensions were driven by two vertical uprights set in the rotary table. After the bit had penetrated the formation about three feet, the clamp had to be removed and raised to a higher position which was governed by the upright driving members. During this change, the crude swivel carried the load of the drill pipe.

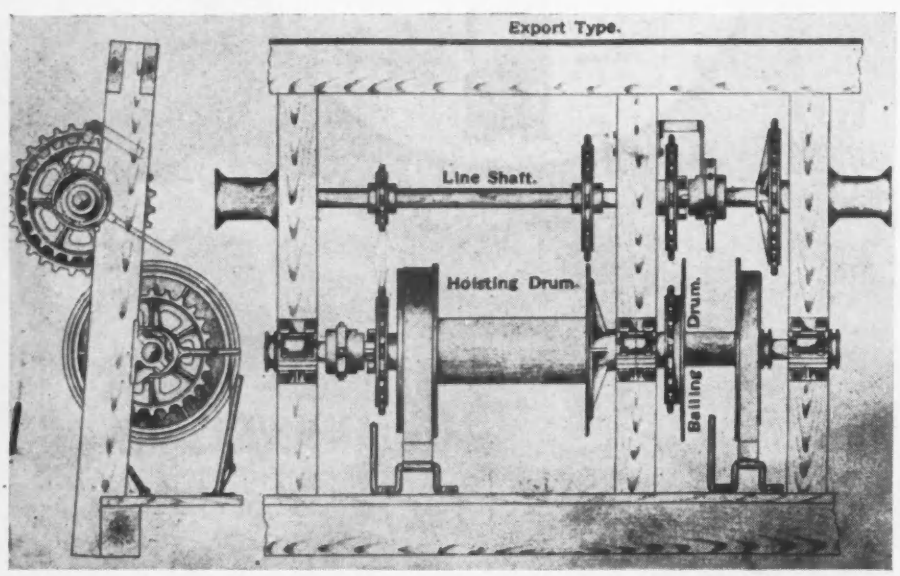

FIGURE 4. De luxe drawworks catalogued in 1907. The line drum was only 12 inches in diameter, with the bailing drum an "extra." It weighed 2800 pounds and sold for $290.

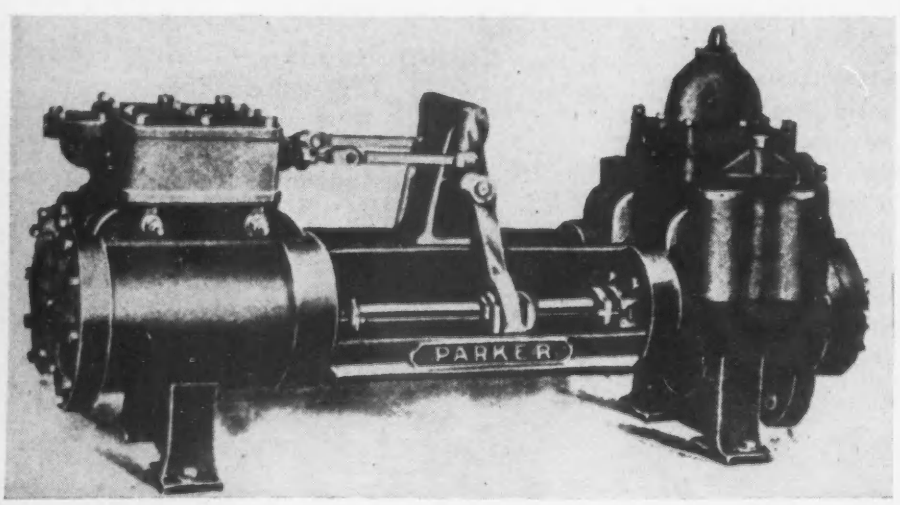

FIGURE 5. Another vintage piece of equipment. This rotary drilling pump had removable cylinder liners, piston packed with flanges on all pipe openings, and was rated up to 175 pounds pressure output. This dupex pump is remarkably similar to present day stream models.

Rotary Drive

By 1906, a new driving device had been introduced to replace the pipe clamp. It was the old gripping rings, made of tool steel, and resembled two large spools that could be pressed tightly around the drill pipe. Flanges of the spools bit into the outside wall of the pipe and rolled on this surface as the drill stem was lowered into the hole. The gripping rings were set in recesses in the rotary table and could be removed. This type is illustrated in Figure 1, which was a typical rig floor scene in the Gulf Coast oil fields for many years following Spindletop. The unguarded drive to the rotary was open end link conveyor chain of cast steel, without pins, bushings, rollers or other means of distributing wear. The rotary table clutch was a sliding open jaw device, which had to be operated by the bracket handle at the rotary and not controlled at the driller's position. Note that the rotary table is kept from jumping off the pinion drive gear by two hooked straps that protruded over the table on either side of the pinion gear. Tension in the rotary chain was maintained by a 2 x 6-inch timber prop. All chains on the drawworks were

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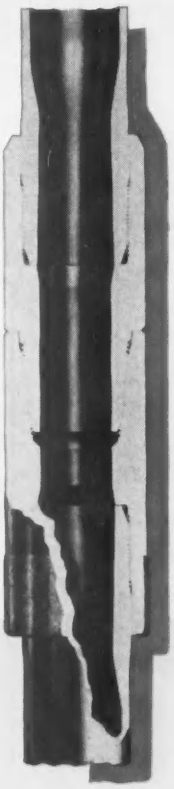

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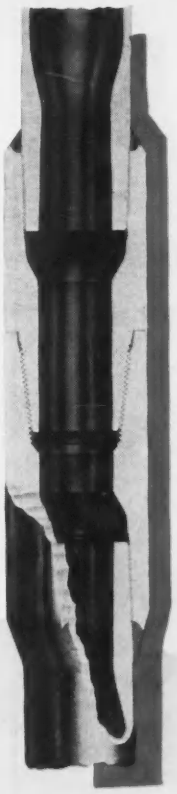

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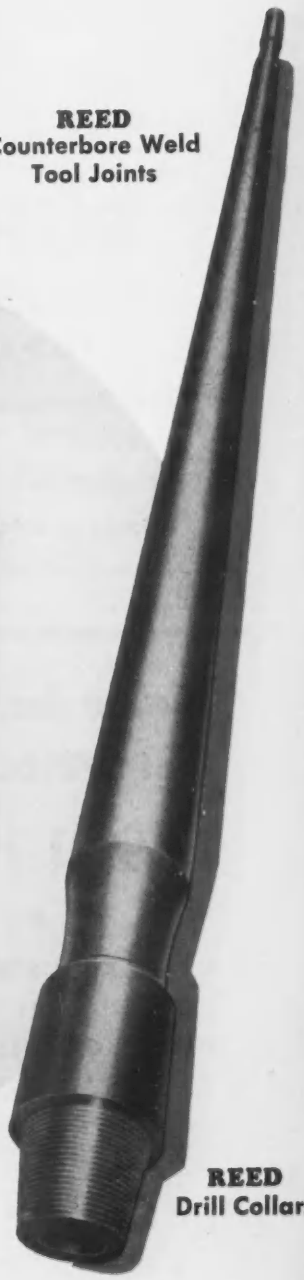

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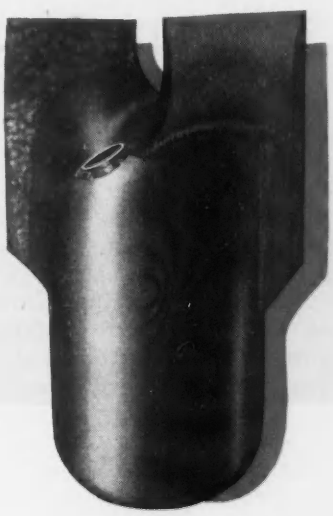

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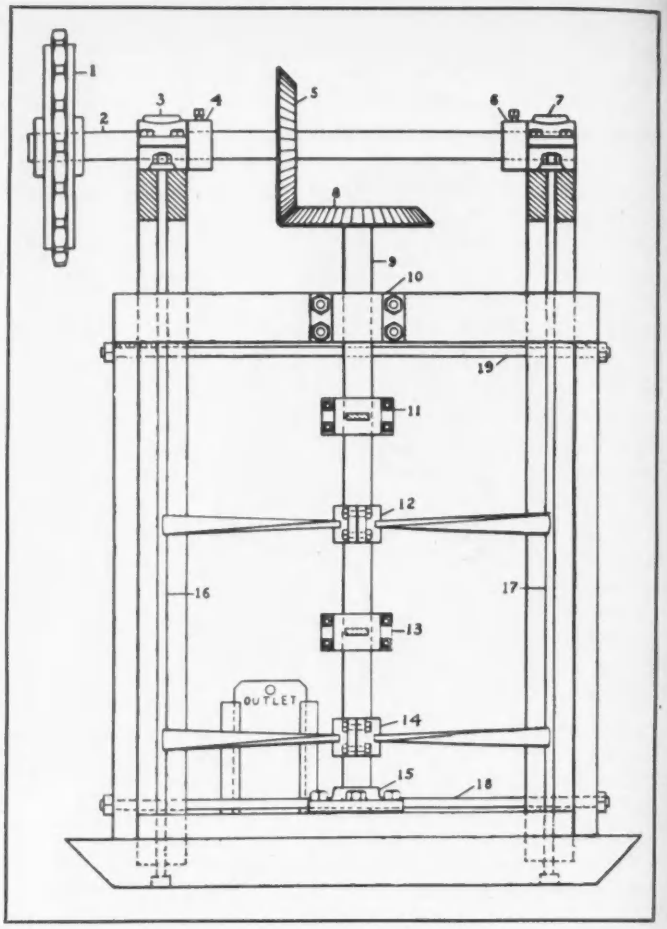

FIGURE 6. This strange item was an early mud mixer. It was driven by a special sprocket mounted on the line shaft of the rotary. Mud in those days (1912) was mixed in batches and dumped by gravity into the reserve or sump pit.

open, and the drum was equipped with only one brake band.

Drawworks in 1906 were available with a dual drum arrangement (Figure 4). In addition to the standard drum, a second drum was used for bailing purposes. Shaft sizes were about 4 inches, and the wire rope drum was 12 inches in diameter. Brake bands were furnished up to six-inch widths.

Steam engines generally used for rotary drilling at that time were of the reversing type, 10½ x 12, with a rated output of 23 horsepower, which according to these early catalogs was adequate for wells up to 3600 feet.

Drilling Muds

Duplex mud pumps were available in 1906 as special equipment to handle mud (Figure 5). For shallow drilling, an 8 x 5 x 10-inch steam driven duplex pump was used. For deeper drilling, a 10 x 5 x 12-inch pump was used. Two pumps per rig was normal practice so that while one pump was operating, the other could be packed. The small pump sold for $330, while the larger was listed for $397.

Mud pumps were normally located on the derrick floor within easy reach of the crew. The mud sump was dug alongside the derrick so the pump intake could drop straight into it. There were no shale shakers in the early days of the rotary. The mud, carrying cuttings from the well, was discharged into a slush pit and a long, narrow ditch, dug around two sides of the derrick, sufficed to knock out any gas entrained in the mud.

Various accounts of early mud mixing are recorded. One published article told of using cattle to stir up surface clay with water to make a drilling fluid. Equipment was designed and manufactured by 1906 for mechanical mixing of surface clay or gumbo with water. The early mud mixer was a wooden, rectangular box with a horizontal shaft set in bearings at each end. Steel paddles mounted on the shaft were rotated by a sprocket at one end of the shaft which was driven by a chain from the drawworks. This driving sprocket on the drawworks was mounted on the line shaft and was one of the "extras" in ordering a drawworks. The mixing process was not a continuous one, but entailed dumping water and clay in the wooden compartment and engaging the driving sprocket to rotate the impellers. After the batch was mixed, it was allowed to flow into a sump, either adjacent to the derrick, or one dug for reserve purposes. An early vintage mud mixer is shown in Figure 6.

Captain Lucas was given credit for the design and invention of a back-

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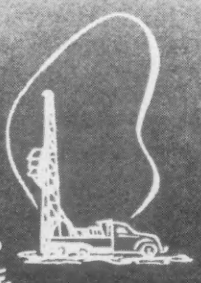

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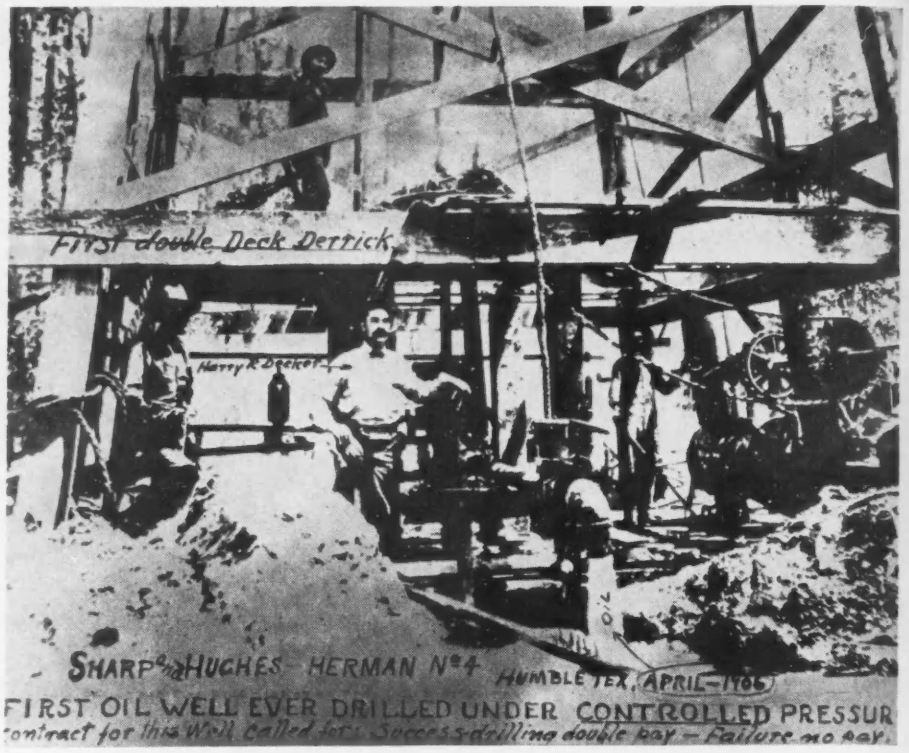
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contract for this well called for: Success-drilling double pay — Failure no pay.

FIGURE 7. This rather blurred photograph marks a milestone in rotary drilling, for it was on this well that controlled pressure drilling was first tried. The well was brought in under complete control, thus ending the days of deliberate "gushers" for which Spindletop was famous.

pressure valve which was placed in the drilling string to prevent back wash of drilling fluid up the drill pipe. By 1906, this valve was placed in the goose neck of the swivel. Dual standpipes were not uncommon, and were made of two-inch pipe about 20 feet in length. Drilling hoses were 30 feet long and were two inches inside diameter, 5-ply heavy wire-armored.

In the early days bits had a habit of twisting off at the coupling between the bit and the drill pipe. With the bit lying at an angle in the hole, it was difficult to fish it out. Believing that the greatest strain in the drill stem existed near the bottom, a few joints of extra heavy drill pipe were employed immediately above the bit. Should the drill pipe twist off, theory was that this break would be above the drill collars and thereby make it much easier to recover the drill collars than the bit alone. The advent of placing weight on the bit from the bottom of the hole through the use of drill collars to relieve compression stress in pipe is a relatively recent practice.

Early Boilers

Early oil field boilers were of the locomotive type, made of flange steel, entirely riveted, and equipped with an exceptionally high stack. A 40-horsepower boiler was about the largest available in 1906, and a 25-horsepower boiler was more common. Price of a 40-horsepower unit was $725.

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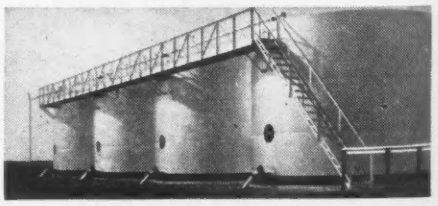

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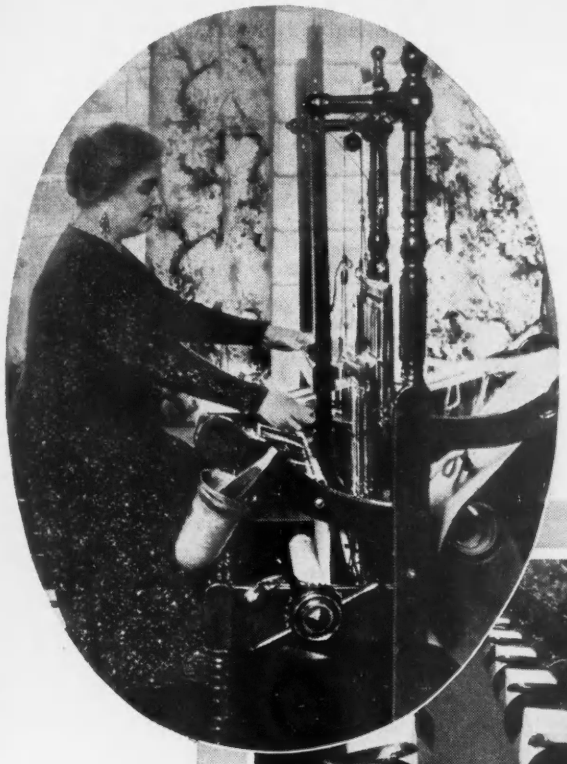

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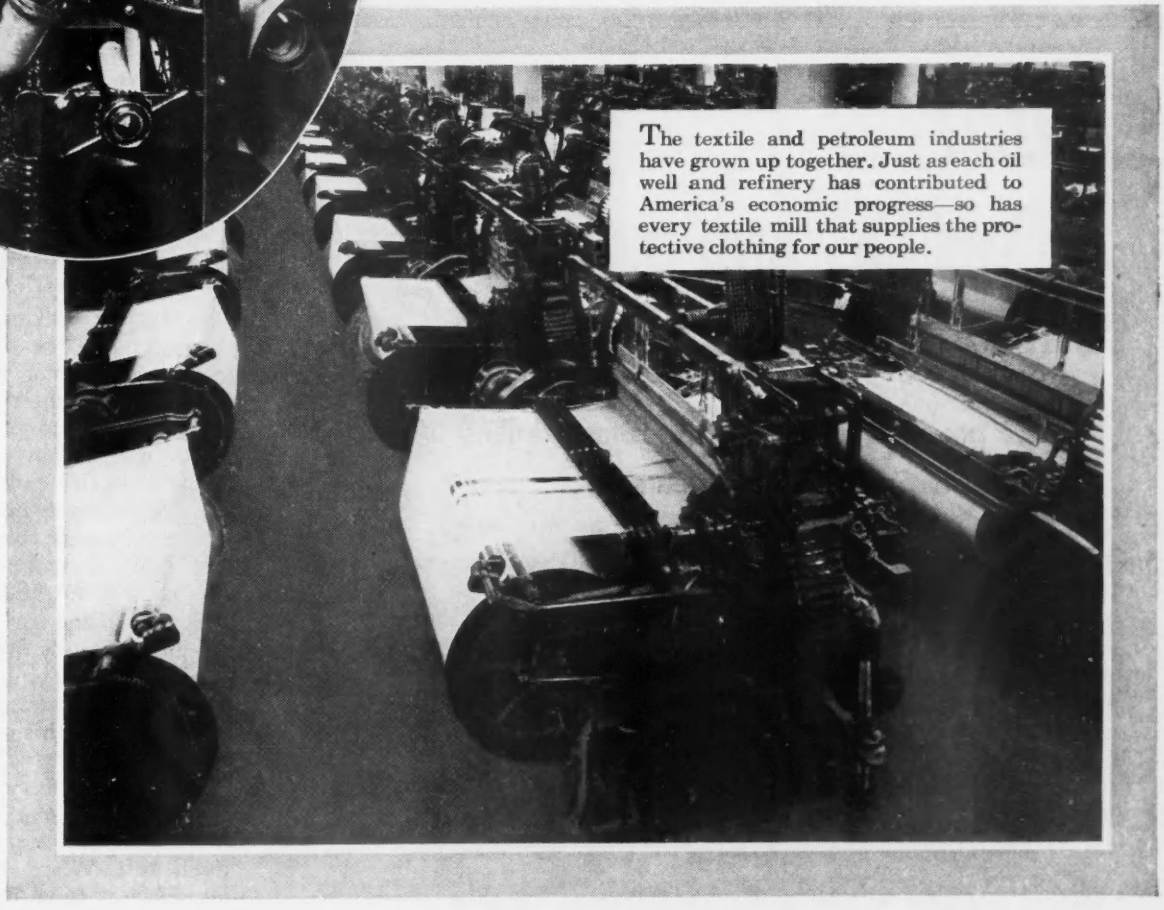

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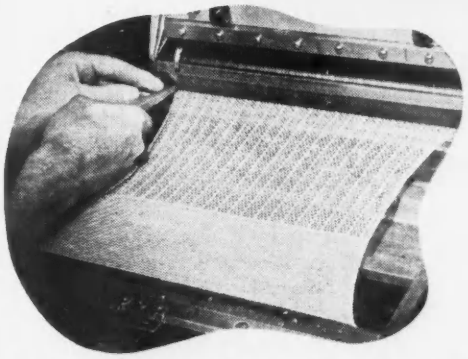

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the wells to gush over the derrick altered the early practice which, according to theory, allowed the wells to "clean themselves." An inventor of that day, Harry R. Decker, devised a simple device which consisted of two interlocking lead seals that fitted around the drill pipe. The lead seals rested in a cast iron bowl that bolted to a tee connection on top of the surface pipe. A seal around the drill pipe was effected by tamping the lead seals into the retainer bowl. This crude packoff method did not permit free rotation of the drill pipe in case the well "kicked," but was primarily designed to prevent and control the initial gushing of oil.

This type of device was used in April, 1906, in the Humble, Texas, field where the first oil well was brought in under controlled pressure. W. B. Sharp and Howard Hughes, Sr., oil operators in the Humble field, made a contract on their Herman 4 for double pay should the well be successful and no pay should the well fail to hit oil. As shown in Figure 7, the well was a gusher, but a controlled one. This illustration also shows the first application of a double-deck derrick where the rotary was located on a platform about 8 feet above the main derrick flood. This arrangement was necessary to permit the use of a packing element around the drill pipe, since at that time cellars below the derrick floor to accommodate blowout preventers and well head equipment had not come into vogue.

Shortly after the success of controlled pressure drilling was realized, blowout preventers began to appear on the market. Figure 8 is an illustration of an early preventer made of two principal parts shaped in the form of hooks which fitted over the flange of the preventer body connected to the surface pipe. Each section contained semi-circular shaped packing glands which were drawn together by right-and-left hand threaded bolts placed on either side of the preventer. These bolts could be rotated by an extension handle that terminated with a wheel at a safe distance.

Early Derricks and Bits

According to Conry[1] the first advance in derricks was in the late 1890s when steel was used in the upper part of the structure. Wooden legs remained to provide some elasticity in absorbing shock. The first all-steel derrick built in this country was made for export to Roumania, where they were common about 1900. The first all-steel rotary drilling rig appeared about 1907.

Source of the early fish-tail bit cannot be definitely stated. Earliest accounts of employing the diamond bit describe it as flat and pointed. It was, perhaps, from this early version of an auger that the two-way fish-tail bit evolved. Since very little was known then about alloys and hard facing, bits of Spindletop days were relatively soft. When drilling in rock or gravel beds, they had to be changed frequently. Making round trips in the dawn of the rotary era was a time-consuming operation. It was for this reason that cable tools could, in hard rock areas, surpass the rotary. This was particularly true in Pennsylvania, Illinois, and even Kansas.

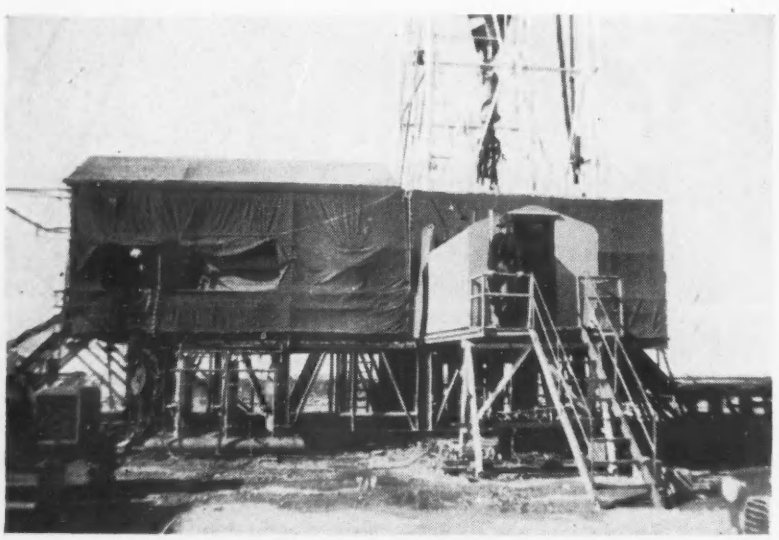
Howard Hughes, Sr., applied for a patent in 1908 for what proved to be the first advancement in rotary drilling bits. It was a two-cone bit designed for drilling in hard formations. The production model of this early rock bit is shown in Figure 9.

Although there were cone-type stone working bits already in use, the most significant contribution of the Hughes bit was the method of mounting the cutters. Full hole coverage was made possible by surrounding the pin and

Salute

TO THE GAS AND OIL WELL DRILLING FRATERNITY

We are proud to be part of the rotary drilling industry pioneered at Spindletop 50 years ago.



Model U-15 Unit Rig Powered by three NKU-225 HP Waukesha engines. Derrick is 128' Oil Well Portable capable of 8500' drilling.

TRI-SERVICE DRILLING CO., INC.

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GULFCO was 'reared' in the BEAUMONT • SPINDLETOP AREA

. . . . which was and is an area of most exacting requirements — an unexcelled proving ground for keeping Gulfco products advanced in design, proved in use,

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Type FO-SS

GULFCO TYPE "FO" TUBING HEADS

are furnished in four principal types. Each type is assembled with one standard full opening forged steel body which is designed for 4000 PSI test pressure or 2000 PSI cold working pressure. Each type can be converted to the other by an interchange of parts regardless of casing size. These tubing heads can be furnished, male or female, in casing sizes from 5" OD to 7" OD to accommodate 2", 2½" or 3" regular or upset tubing. Two 2" API line pipe side outlets are regularly furnished. Special adapters for installation of gate valves, oil savers and other production equipment can be furnished on short notice for the type "FO" Tubing Heads.

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- Casing Heads
- Tubing Heads
- Casing Head and Tubing Head Adapters
- Stripper Rubbers
- Stripper Rubber Pullers
- Christmas Tree Fittings: Adjustable Chokes . . . Positive Chokes . . . Bull Plugs . . . Crosses . . . Tees and Ells
- Quick Change Crosses and Tees: Tie Rods . . . Tie Rod Clamps . . . Flanges and Flange Unions . . . Nipples
- Casing Shoes
- Slush Pump Liners
- Low-Pressure Gas Burners
- Low Water Alarms
- Emergency Fuel Shut-Offs
- Boiler Feed Water Regulators
- Gas Firing Controls

GULFCO pays tribute to the pioneers who discovered and developed Spindletop—the field that started the new epoch in the oil industry. Our company and many another is indebted to their enterprising spirit which has brought untold wealth to the world.

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SPINDLETOP 1901-1951
Where Oil Became an Industry

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Rotary Drilling West Texas and New Mexico

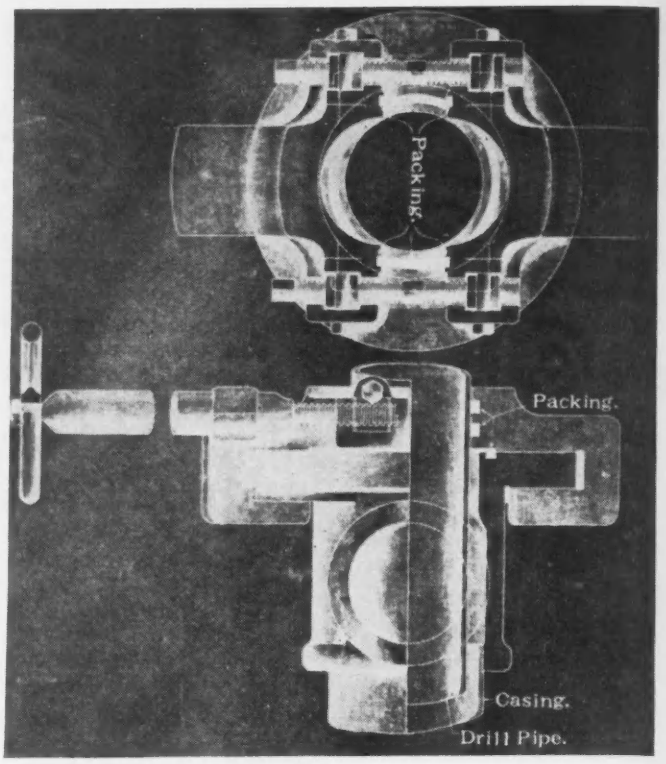


FIGURE 8. Phantom view of an early blow-out preventer which was designed to be operated by extension handles.

bearing with the cutting cones. Later developments included a lubricator, a unitized cone, hard facing on cones, tri-cones with interfitting teeth, and numerous other improvements. The cross-roller bit was introduced in 1913 in Louisiana and many important advancements have been made in it. The fish-tail bit continues to find application, and the advent of hardfacing material about 1926 materially increased its useable life. Shale shakers were introduced about 1929 as a means of mechanically segregating the cuttings from the drilling fluid. Although the Froude water brake was invented in 1870, and its principle applied in other industries prior to 1920, it was not until about 1930 that it was applied to drawworks to arrest the fall of the travelling block.

Progress Rapid

Since the end of World War I, progress in the development of drilling equipment and techniques has been rapid. Equipment began to grow in size and weight to permit deeper and deeper drilling. By the end of World War II, the appearance of many automatic features became more frequent. In 1949 a well was drilled in Wyoming to a total depth of 20,521 feet without appreciable difficulty.

Operating such powerful machinery proved to be quite fatiguing to the crew. Recent trends in rotary drilling have been toward "super" automatic operation and unitization.

REFERENCES

[1] John J. Conry, "Well Drilling Methods," The Oil Weekly, Nov. 3, 1941. p. 63.

[2] J. V. Pennington, "The History of Drilling Technology and Its Prospects," 29th Annual Meeting, API, November 9, 1949, Chicago.

[3] Southern Well Works Co., Beaumont, Texas, catalog, dated 1907.

[4] C. A. Warner, "Texas Oil and Gas Since 1843," The Gulf Publishing Company, 1939, pp. 20, 28, 29.

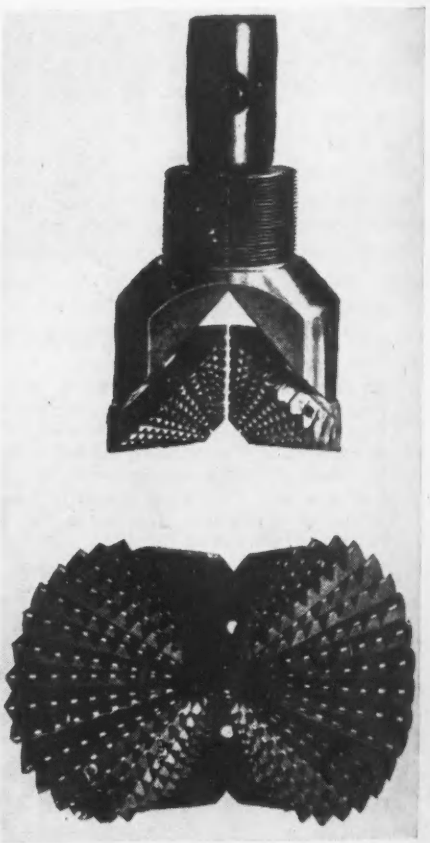
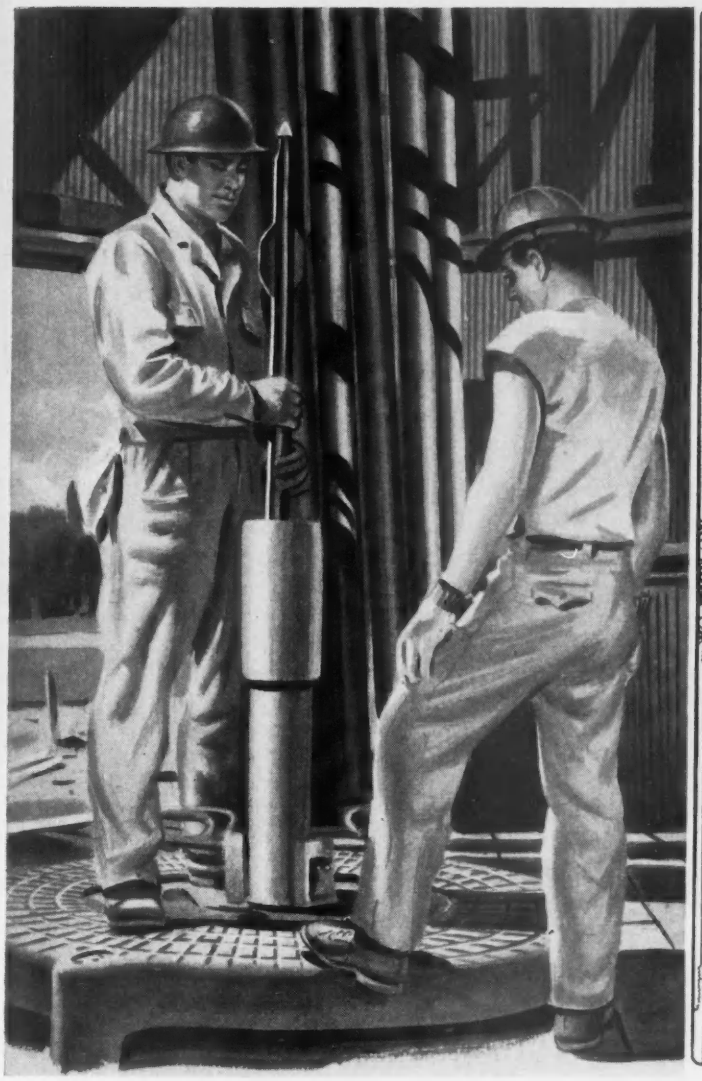
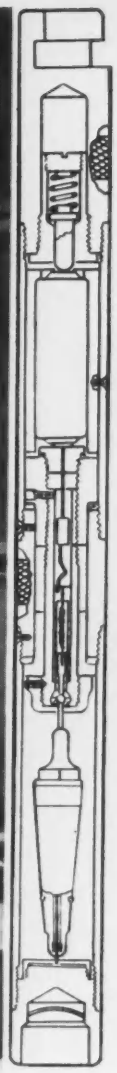


FIGURE 9. Early production model of the drill bit.





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Your's with the E-C Inclinometer

SPERRY-SUN SERVICE on its instruments means they are serviceable when you are ready to use them.

The E-C Inclinometer records *automatically* and *immediately* after coming to rest. It can be go-deviled or lowered into the hole on a line by any conventional method in either rotary or cable tool operation.

The record is made by small electrical current which makes a dot on the recording disc only when the E-C is at rest. To double-check with an E-C, just raise it a few feet and again lower it to the previous depth. In this way you check for movement of the instrument and alignment of the axis of the instrument with the axis of the drill collar. Your reading's accuracy is then checked and double-checked.

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THE
PIONEER

Commemorating the 50th Anniversary of Spindletop

Since its founding in 1919 as the Hull Iron Works, the Texas & Louisiana Tool Co. has pioneered in the development of specialized oil tools. Following a merger with the Spindletop Machine & Supply Co. in 1926 the present name was adopted and the pioneering of the company was continued.

TEX-LA
SPECIALIZED OIL FIELD PRODUCTS

Mud Line Fittings – Wash-Down Swivel – Break-Out Tong Line Guide – Dead Line Clamps – All-Steel Finger Boards – Rotary Drilling Bits – Reamers – Stabilizers – Milling Tools

This 6000 lb. test Goose Neck is typical of the rugged manufacture found in all TEX-LA products.

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CAPTAIN LUCAS

--Titan of Spindletop

SYNONYMOUS with the greatness of Spindletop is the man whose courage, faith and drive played such a prominent part in the discovery of this history-making oil field—Captain Anthony F. Lucas.

Born in Spalato, Dalmatia, Austria, as Anthony Luchich, Captain Lucas was the son of a ship builder and ship owner, Captain Francis Stephen Luchich, and his wife, Giovanna Giovanizio, of Montenegrin descent. When Anthony was six years old, his family moved to Trieste, Austria, where he received his primary education. At the age of 20, he graduated from the Polytechnic Institute, Gratz, and then entered the Naval Academy of Fiume and Pola from which he graduated in 1878. The following year he visited an uncle in Saginaw, Mich., and became so interested in the lumber industry that he resigned his commission in the Austrian navy, followed his uncle's example by changing his name to Lucas, and applied for American citizenship.

From 1879 to 1893 he was interested in the lumber industry, and then became a consulting mechanical and mining engineer, with offices and residence in Washington, D. C. In 1893 he accepted a position as mining engineer for a salt mining company at Petit Anse, La. During his three years with this firm, he became interested in the occasional mounds of low elevation occurring in the Gulf Coastal plain areas of Louisiana and Texas, and in 1896 he began privately to study these so-called domes. In the course of his work, which involved prospecting with a diamond drill, he located a number of great deposits of rock salt and also studied the seepages of petroleum and sulfur from other domes. He concluded that these elevated areas were geological structures distinct from the surrounding sedimentary deposits and that the areas showing seepages on the surface were in reality natural reservoirs of petroleum.

A. F. Lucas

On the basis of this theory, he selected an elevated area known as Big Hill, now Spindletop, near Beaumont, Texas, leased 220 of its 300 acres, and then sought financial aid to undertake drilling for oil. Because of his unusual theory, for which there was no proof in any oil field, Lucas could secure aid only by relinquishing the larger part of his interest in the undertaking. Operations were begun on October 27, 1900, using a crude form of hydraulic rotary drilling. After successfully overcoming difficulties with quick sand by devising a check valve which he failed to patent, he struck oil at 1139 feet on January 10, 1901.

The Lucas Gusher on Spindletop started a new era in the oil industry, but while Lucas, as the discoverer, became famous the world over, his own financial reward was negligible. He died in 1921, and in his honor the American Institute of Mining and Metallurgical Engineers established in 1936 the Anthony F. Lucas Medal to recognize "distinguished achievement in improving the technique and practice of finding and producing petroleum."

These awards are the first recognition by any professional society for outstanding contributions to oil "mining." The awards are financed from the income of the Anthony F. Lucas Memorial Fund which was started shortly after Lucas' death. The medal has been awarded to the following oil men: 1937, J. Edgar Pew; 1938, Henry L. Doherty; 1939, no award; 1940, E. DeGolyer; 1941, Conrad and Marcel Schlumberger; 1942, no award; 1943, John Robert Suman; 1944, Charles VanOrmer Millikan.

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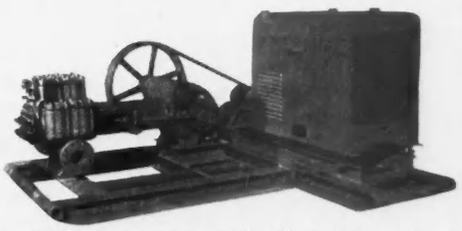

SPECIFICATIONS: GASO Model 1860, 4½" x 6". Totally enclosed Duplex Power Pump, Timken bearing equipped, side pot type fluid cylinders, bronze wing guided valves, stainless steel rods, pump furnished with 2½", 3", 3½", 4", 4½" cast iron liners with steel rings whichever size requested. 4" suction and discharge. Pump has 28.8", 5-C Groove Sheave.

Liner Size	Pressure Lbs./Sq. In.	DISPLACEMENT 70 R.P.M. GPM	70 R.P.M. BPH	90 R.P.M. GPM	90 R.P.M. BPH
2½"	900	32	46	41	59
3"	600	47	67	61	87
3½"	450	65	93	85	121
4"	350	88	126	112	160
4½"	300	112	160	144	205

Note: Bronze liners and pistons can also be furnished at slight additional cost.

CHRYSLER C-36 Industrial 9, Eight cylinder engine, 323.5 cu. in. displacement, complete with starter, generator, large radiator, air cleaner, oil filter and clutch with sheave and 5-C-144 V belts, gasoline carburetor. Engine is fully enclosed. Less battery.

50 H.P. CONTINUOUS AT 1200 RPM

Reconditioned unit has 2 piece steel H-beam skid as shown. Shipping weight approximately 6000 lbs. for unit.

Halloran Equipment Co.

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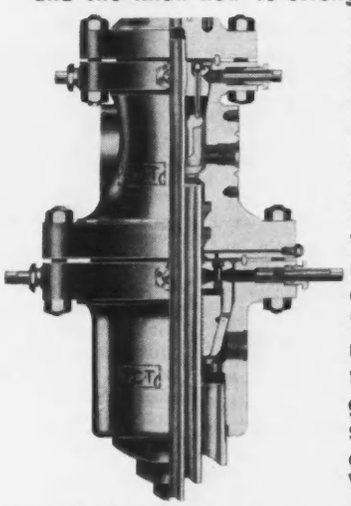
Beaumont Well Works is equipped with the tools and the know-how to strengthen your product with forgings. Carbon, alloy, and stainless steel forgings made to your specifications will help reduce your costs of manufacture and will put more sales appeal in your product. Now, without investing a cent in forge equipment, you can compete successfully with the largest manufacturers of oil field equipment. Investigate the advantages of steel forgings, then call on Beaumont Well Works for specific engineering and manufacturing information concerning your product.



An example of the strength and safety built into a product by Beaumont Well Works Forgings.

Commemorating the Fiftieth Anniversary of Spindletop.

BEAUMONT WELL WORKS COMPANY
INCORPORATED
BEAUMONT, TEXAS

NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Slush Pump Piston

This item supplements MacClatchie Manufacturing Company data on pages 3017-3044H of Composite Catalog, 17th Edition.

A new type HD slush pump piston permits the changing or original installation of rubbers without disassembly. The installation requires only removal of the piston rod nut and a follower, and end plates, center rings and rubbers can then be slid off the rod.

The main body of the piston never comes in contact with liner surfaces; all the wear is absorbed in the rubbers.

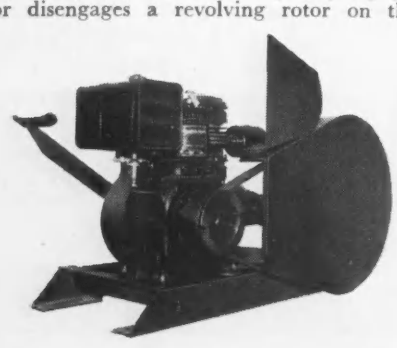
For additional information write MacClatchie Manufacturing Company, Compton, Calif.

Engine Starter

This item supplements United Supply and Manufacturing Company data on page 4832 of Composite Catalog, 17th Edition.

A new engine starter for 5- to 90-horsepower engines has the pull-rope on the outside of the starter, away from the engine. This location gives the operator more freedom and safety, the manufacturer claims.

When the starter engine is running, the operator, by pushing a foot pedal, engages or disengages a revolving rotor on the rim of the engine's fly wheel. Because the operator engages the rotor with a foot pedal, he has his hands free to make starting adjustments on the engine. The starter is available in five sizes and powered with either a single or twin-cylinder engine.



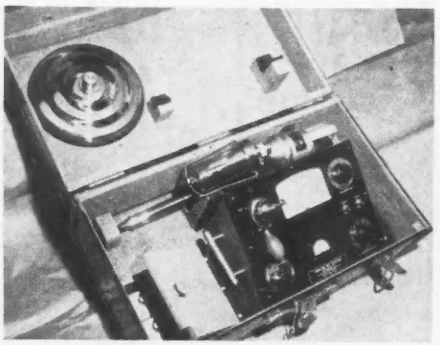
For additional information, write United Supply and Manufacturing Company, 624 South Boston, Tulsa 3.

Gas Detector

This item supplements Petroleum Instrument Company data on pages 4100-4101 of Composite Catalog, 17th Edition.

The portable Formation Gas Detector assists the geologist or drilling personnel in checking for the presence of formation gas in cuttings, cores, and mud from the flow line. The unit is composed of a high-powered, motor-driven stirring device and a small cabinet that contains the indicating meter and other electrical devices. The entire instrument is contained in a carrying case approximately 30 x 18 x 12 inches and weighs 75 pounds.

In operating the instrument, the specimen to be tested is placed in a steel jar,



sealed and stirred for a short while by the electrical mixing unit. This liberates any gas contained in the sample; this gas and air mixture is then drawn into contact with the detecting filament and the amount present is indicated in the usual gas units. Methane or total gas may each be determined separately.

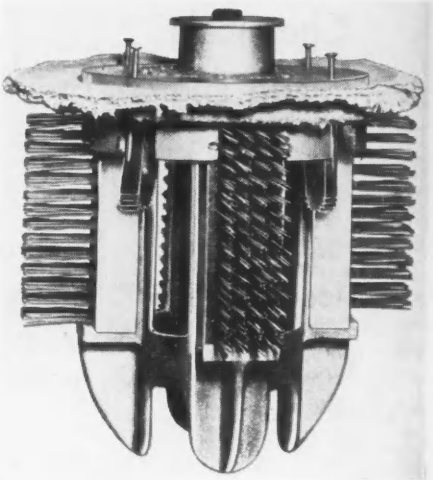
For additional information, write Petroleum Instrument Company, 220 West Alabama, Houston.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

Bridging Plug

This item supplements The Cavins Company data on pages 1166-1171 of Composite Catalog, 17th Edition.



An off-bottom bridge on which cement, sand, etc., can be dumped is formed by the new Cavins bridging plug, made of drillable material. Canvas seal rings from a base on which the material to be dumped comes to rest when it is unloaded. Any tools used to drill out or break up cement will easily destroy the bridging plug, the manufacturer states.

The plug is set in the casing by attaching the disc on top of the plug to the Cavins dump bottom, which is used as a setting tool, and lowered to the desired point. Raising the dump bottom releases the fingers which have secured the plug to the bottom. When the plug is thus released, notched dogs, which are Hinged to swing outward, are also released and engaged with the casing walls to secure the plug against downward movement when the setting tool or other tools are used to feel for bottom. Friction brushes prevent ordinary movement of the plug until the engaging dogs take hold.

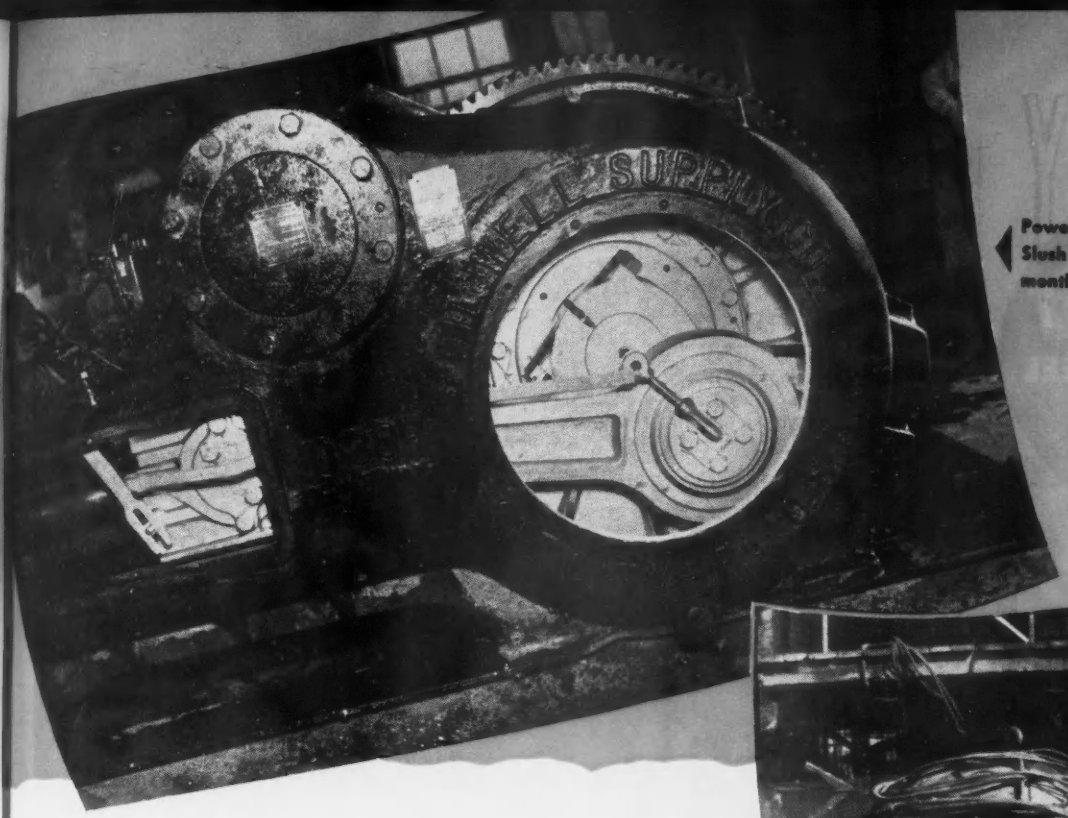
For additional information, write The Cavins Company, 2853 Cherry Avenue, Long Beach 6, Calif.

Rod-Wear Detector

This item supplements Tuboscope Company data on pages 4790-4791 of Composite Catalog, 17th Edition.

A new electrical rod-wear detector for tubing weighs only 20 pounds and can be operated by one man. It is designed for rod-wear inspection of tubing on the rack. The instrument is available on a service or rental basis in the Mid-Continent and Gulf Coast areas.

For additional information, write Tuboscope Company, 2400 Holmes Road, Houston.



Power-end view of this "Oilwell" No. 20-P Slush Pump ready to return to service after months under water.

View of this "Oilwell" No. 20-P Slush Pump submerged in flood waters. Note the sheave, which drives the pump, barely visible above the water on extreme right hand side.

"Oilwell" Slush Pumps are *Built to last...*

BACK IN 1937, this No. 20-P Duplex Power Slush Pump went into operation. Since then it has been used in the drilling of 36 wells—a total of 324,000-feet of hole—in Louisiana, Mississippi and Texas. Included in this footage were many wells of 10,000-foot depth, one over 11,000-feet.*

In 1938 this pump was inspected, following a period of emergency operation when it was overloaded; but the only replacements necessary were crosshead pins and bearings. The pump continued to give excellent service with no major replacement of parts, other than such expendable fluid-end maintenance parts as, pistons, rods, liners and valves.

Under water for 6 months . . . back into service with only minor repairs necessary

Operating in Alabama this "Oilwell" No. 20-P Pump was flooded on November 24, 1948. The flood waters receded early in May, 1949 but the location was reflooded before the pump could be moved. Finally on June 1, 1949 it was removed to a shop for inspection.

The only work required to put the pump back into first class condition was, (1) the replacement of the right-hand crosshead pin and bearing, which showed signs of wear after their 10-year service, (2) inside of pump was cleaned then flushed with light oil, and (3) the lubricator was dismantled and cleaned.

"OILWELL" No. 220-P PUMPS

. . . are the present heavy-duty successors to this earlier No. 20-P model embodying all the time-proved design features which make long, dependable, service records such as this possible . . . with even greater "factors of safety," larger H.P. input ratings and increased volume/pressure capacities.

COMPARE Specifications and Prices Before you BUY!

There's an "Oilwell" pump of the right size and capacity for every drilling requirement in this extensive line.

Pump No.	Max. Size by Stroke	Rated R. P. M.	B. H. P. Rating
No. 220-P	8" x 20"	60	600
No. 218-P	7¼" x 18"	60	450
No. 14P-HD	7¼" x 14"	65	325
No. 712-P	7¼" x 12"	70	220
No. 612-P	6" x 12"	70	140
No. 12-P	5" x 12"	70	100
No. 8P-HD	5" x 8"	80	85
No. 6P-HD	4" x 6"	100	40

**"Oilwell" Representatives will identify owner of this No. 20-P Pump on request . . . and GIVE YOU FACTS to help you decide on the best pump for your job.*

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UNITED STATES STEEL

PENBERTHY
REFLEX and TRANSPARENT
DROP FORGED STEEL
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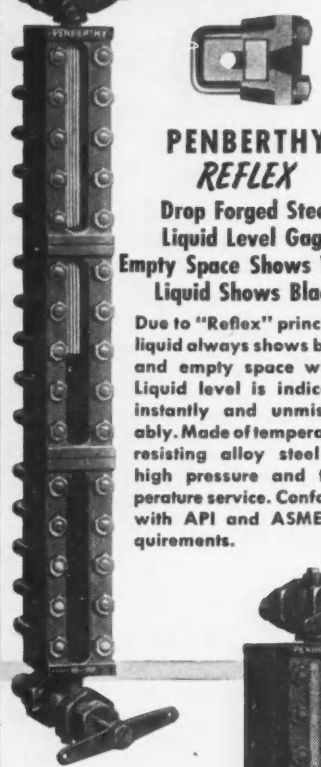
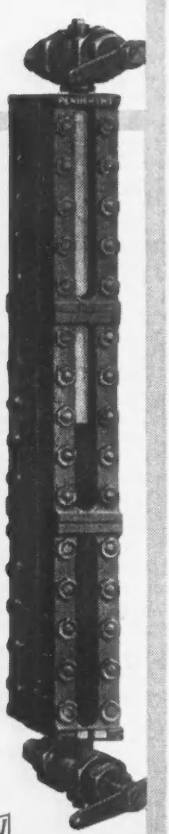
GAGES



PENBERTHY
REFLEX
Drop Forged Steel
Liquid Level Gage
Empty Space Shows White
Liquid Shows Black

Due to "Reflex" principle, liquid always shows black and empty space white. Liquid level is indicated instantly and unmistakably. Made of temperature resisting alloy steel for high pressure and temperature service. Conforms with API and ASME requirements.



PENBERTHY
TRANSPARENT
Drop Forged Steel
Liquid Level
GAGES

Glass front and rear permits observation of color and density of liquids under high pressures and/or temperatures. Highest quality—made of temperature resisting alloy steel. Conforms with API and ASME requirements.

3277-C

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Gas Mask

This item supplements Mine Safety Appliances Company data as shown on pages 3308-3309 of Composite Catalog, 17th Edition.

The M-S-A Demand Mask, for 30-minute respiratory protection in toxic or oxygen deficient atmospheres, is a self-contained breathing apparatus which is U. S. Bureau of Mines approved.

For fire fighting and industrial emergencies, the mask provides the wearer with a full half-hour of oxygen or pure compressed air, supplied automatically according to the individual breathing needs. The mask, complete with oxygen or air cylinder, weighs only 32 pounds, and allows freedom of movement and unobscured vision.

In addition to the standard mask, a front-type unit is available to be carried on the wearer's chest, providing respiratory protection for 8 to 10 minutes. Both types may be equipped with an M-S-A Cleartone speaking diaphragm which permits unrestricted verbal communication and use of telephones.

For additional information, write for Bulletin No. B-20, Mine Safety Appliances Company, Bradock, Thomas and Meade Streets, Pittsburgh 8.

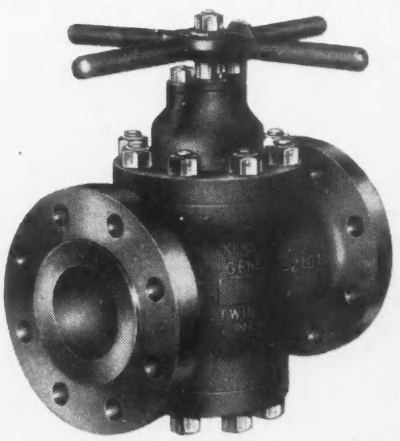
Plug Valve

This item supplements Kerotest Manufacturing Company data on pages 2613-2632 of Composite Catalog, 17th Edition.

A new non-lubricated plug valve, the Kerotest General Twin Seal Valve, is available for operation in normal to sub-zero temperatures on all types of gaseous and volatile liquid service.

Because no lubrication is required, daily maintenance of the valve is eliminated. The valve is operated from full open to full closed through 1¼ turns. Valve seats retract before rotation of the plug, to prevent wear, scoring, galling or sticking. Individual seats expand against body ports in closed position for vapor-tight shutoff. Seat inserts are replaceable through bottom plate without disassembly.

The valve is available with either flanged or screwed ends in sizes from 2 to 8 inches for cold working pressures from



230 to 2000 psi, and sizes 2 to 4 inches for cold working pressures of 3000 to 5000 psi.

For additional information write Kerotest Manufacturing Company, 2539 Liberty Avenue, Pittsburgh.

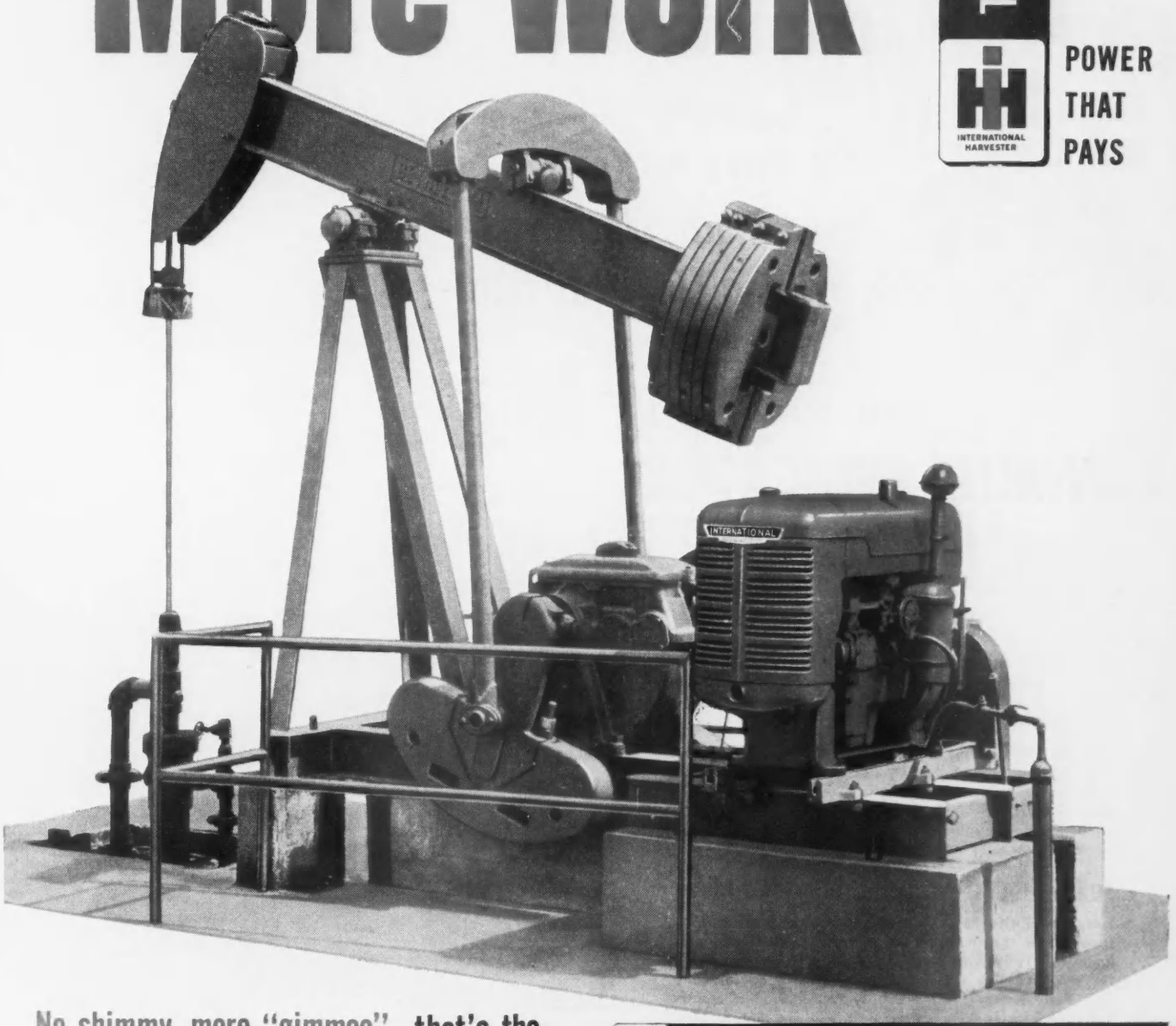
Specify
PELCO
Welding Saddles
PELICAN WELL TOOL & SUPPLY CO.
P. O. Drawer 1108
Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE

No Jerk More Work

INTERNATIONAL

INTERNATIONAL HARVESTER

POWER THAT PAYS



No shimmy, more "gimmee"—that's the big pumping benefit of International multi-cylinder power

Smooth-flowing power with plenty of real "lift"—that's what International multi-cylinder power offers.

Five sizes—up to 49 HP (API max.)—to handle your pumping job. Five big reasons to buy:

Adaptability. Endurance. Economy. Service facilities, all through the oil fields. And the International Reputation for power that pays!

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INTERNATIONAL HARVESTER COMPANY
P. O. Box 7333, Chicago 80, Ill.

Please send me a copy of your catalog, A-384-NN International Oil Field Pumping Engines.

Name_____

Address_____

City_____ Zone____ State_____

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Heating Centrifuge

This item supplements L-K Pump Valve Company data on pages 2826-2831 of Composite Catalog, 17th Edition.

A thermostatically controlled electric heating centrifuge, made by W. L. Melton Company, heats the samples in a pre-heating tube compartment and in the thimbles attached to the two-way head of the centrifuge proper.

The oil sample will retain set temperatures during the rotating of the centrifuge for true tests of high paraffin content or other high viscosity oils. The machine has heavy gauge steel housing with full size aluminum and cast iron base.

Centrifuges are available for handling

12.5 ml API tubes or 15 cc tubes, and for 100 ml ASTM pear shaped or 200 cc pear shaped tubes. An external switch and thermostat regulate the flow of current from the car battery to the heater and tube thimbles of the two-way centrifuge, simultaneously.

The motor pulls seven amps while 10 amps are used for heating during the first ten minutes.

For additional information write L-K Pump Valve Company, 632 North Edgewood, Houston.

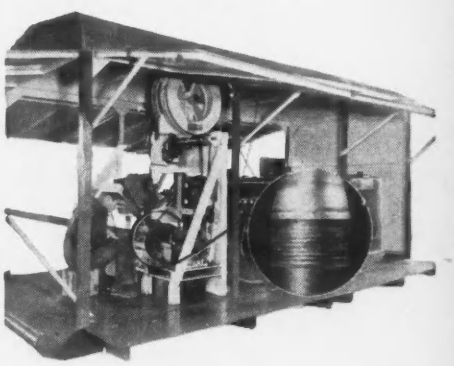
Welding Service

This item supplements Hunt Tool Company data on pages 2353-2384 of Composite Catalog, 17th Edition.

An automatic welding machine for hard-facing the outside of tool joints and drill collars is available on a service basis.

It is portable and is transported in a float truck so that it may be set up at the well site. It hardfaces the o.d.'s of tools automatically and continuously.

First the tool joint is preheated, then a high chromium rod is applied. Tungsten



carbide is applied in the valleys of the first weld. The machine provides a smooth, tough weld and does not set up internal stresses in the tool joints.

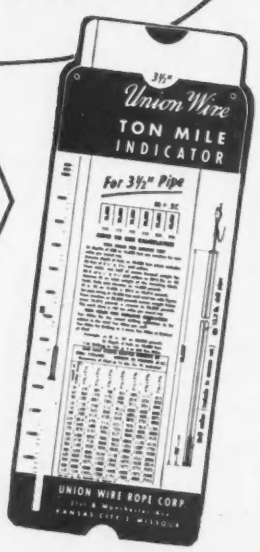
For additional information write Hunt Tool Company, 1945 Cullen Boulevard, Houston.

It Pays to Know How Much Work Your Drilling Line Has Done

THE UNION WIRE

TON-MILE INDICATOR

TELLS YOU



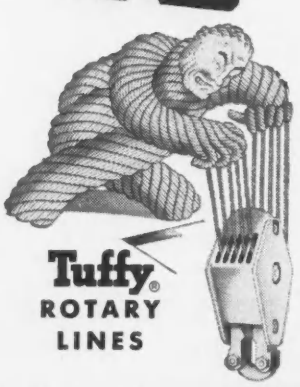
Cutting off drilling line too soon wastes useable rope. Running it to the point of overloading increases risk of costly fishing jobs.

What to do? Many drillers are using work analysis methods to establish the correct points for line cut off. More efficient rig operation and lower ultimate wire rope costs are resulting.

With the Union Wire Ton-mile Indicator, it's easy to do. With it is a Union Well Log Book. Set your log book figures on the Ton-Mile Indicator and read the answer. The Union Ton-Mile Indicator does all the complicated figuring. Send for your Ton-Miler today. With it you can prove to your own satisfaction that—

Tuffy Rotary Lines Deliver More Ton-Miles

Tuffy **Jackknife** Rotary Line is designed to move at high speeds over the smaller sheaves and drums of the jackknife rig. Tuffy **Standard** Rotary Line is recommended for standard rigs and for deeper drilling on jackknife rigs. Tuffy Rotary Lines are easy to order. Just specify Tuffy **Jackknife** Rotary Line or **Standard** Rotary Line, the length and the size. No complicated specifications.



MAIL THIS COUPON

union Wire Rope corporation

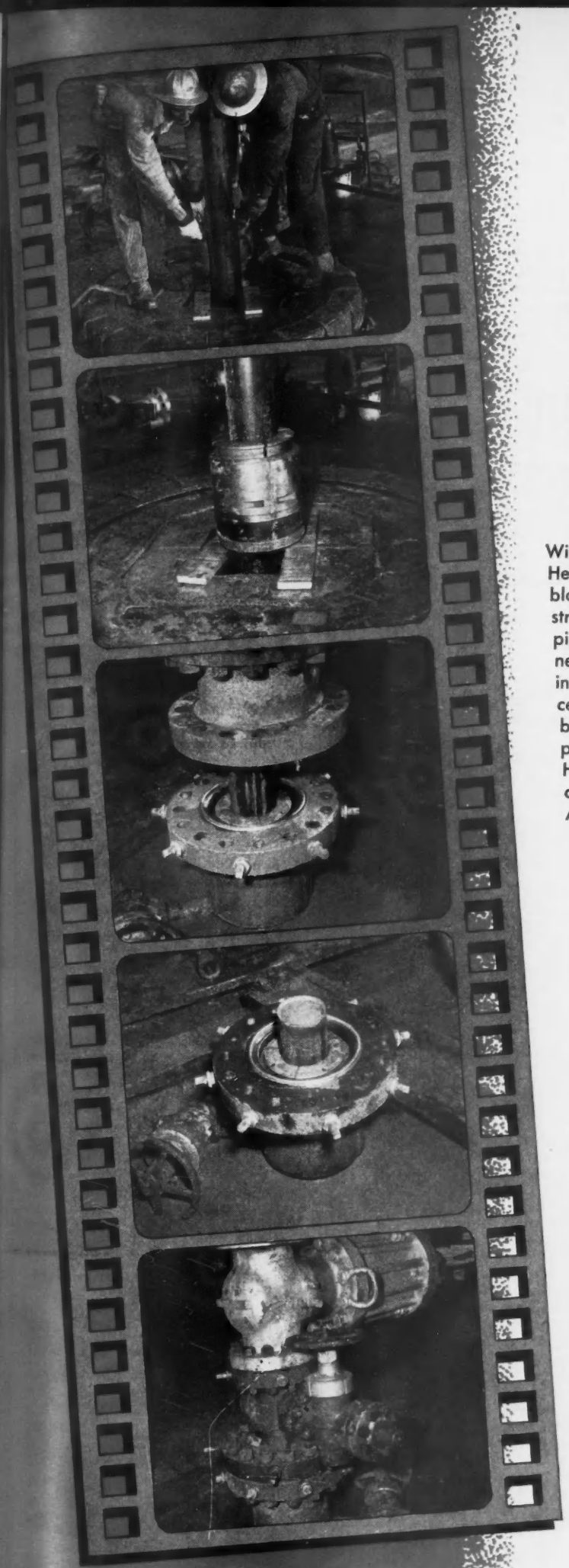
Gentlemen: Please have a Union Fieldman deliver my Ton-Mile Indicator and Union Log Book and explain its use.

UNION WIRE ROPE CORPORATION
2104 Manchester Ave. Kansas City 3, Mo.

Firm Name .....

Address .....

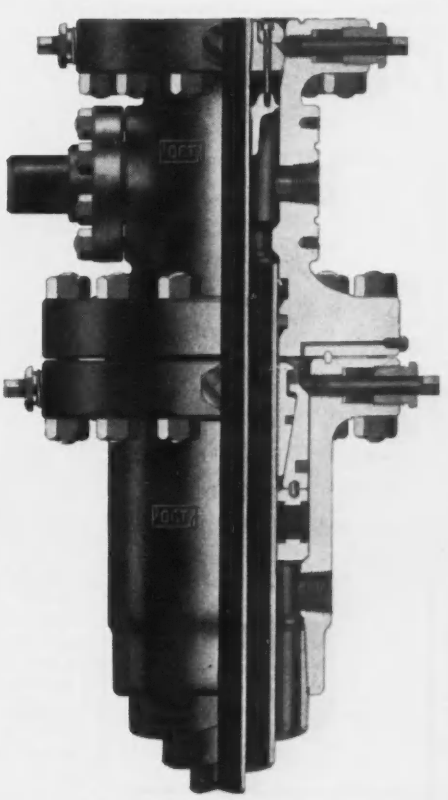
City ..... Zone ..... State .....



It's the only Casing Head that meets every well completion problem with a single compact model.

O-C-T C-19 Casing Heads Set, Seal and Protect before Preventers are removed

With the quick setting and automatic sealing O-C-T C-19 Casing Head, your well is closed in positively around the casing before blowout preventers are unflanged. The space between the strings is safely sealed so that blowouts cannot occur while the pipe is being cut off, the blowout preventers set aside and the next head installed. No manual work is required to apply sealing compression to the seal ring. Slips set evenly, automatically centering pipe, and slip tooth pressure is uniform from top to bottom and around the pipe. The entire series of operations pictured at left required to install the O-C-T "C-19" Casing Head is conducted without leaving any remote possibility open at any time for your well to pressure up and blow out. Ask your O-C-T Representative or write for complete details.

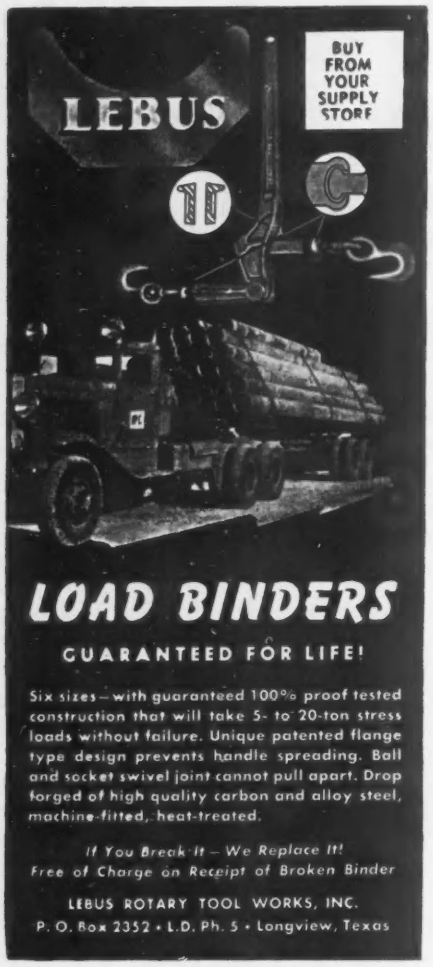


Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

Export Representatives: Venezuela, Colombia, Peru, and Ecuador — Berry & Hall, Apartado No. 304, Maracaibo, Venezuela. Sterling Areas—Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.

OCT PRODUCTS—dependable and available through more than 700 supply store locations



LOAD BINDERS

GUARANTEED FOR LIFE!

Six sizes—with guaranteed 100% proof tested construction that will take 5- to 20-ton stress loads without failure. Unique patented flange type design prevents handle spreading. Ball and socket swivel joint cannot pull apart. Drop forged of high quality carbon and alloy steel, machine-fitted, heat-treated.

If You Break It — We Replace It!
Free of Charge on Receipt of Broken Binder

LEBUS ROTARY TOOL WORKS, INC.
P. O. Box 2352 • L.D. Ph. 5 • Longview, Texas

PARKERSBURG MACHINE CO. PARMACO PARKERSBURG, W. VA. U.S.A.

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PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

Ask your favorite Supplier to get information on the New PARMACO STEEL CASING HEAD.

SEE OUR CATALOG IN COMPOSITE CATALOG

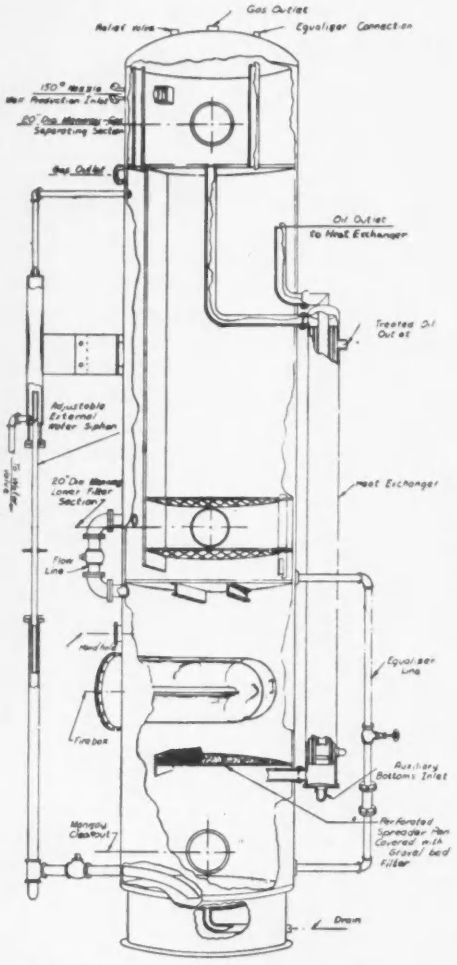
PARKERSBURG MACHINE COMPANY
PARKERSBURG, W. VA.

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Treater

This item supplements Black, Sivalls & Bryson, Inc., data on pages 714-748 of Composite Catalog, 17th Edition.

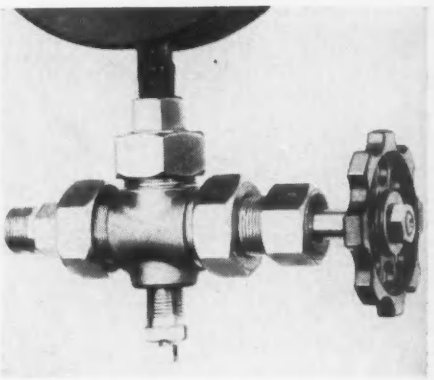


The field tested Type "J" treater consists of a large vertical shell divided into three sections. In the separator or top section, "cold" separation of gas and oil takes place. In the bottom section is included a large capacity firebox which serves as a heater and water knockout. The settling or middle section of the treater is a large capacity quiet zone for the final separation of oil and water. The three sections are independent of each other, being separated by heavy diaphragm plates. Each section may be drained or inspected separately. This model has (1) immersion twin-tube firebox which gives higher heating efficiency, (2) a new improved heat exchanger, (3) improved distribution of emulsion flow through the heating section, and (4) a firebox which may be inspected without draining complete treater. This saves time, reduces maintenance costs, and prevents untreated oil from entering the tanks when the treater is returned to service. Surfaces of large gas separation section are wetted by oil, thus reducing corrosion. The treater delivers cool, stable oil to stock.

For literature, write Black, Sivalls & Bryson, Inc., 7500 East 12th Street, Kansas City, Mo.

Instrument Piping Valves

This item supplements Jerguson Gage & Valve Company data on page 2553 of Composite Catalog, 17th Edition.



A new line of valves for instrument piping and general use reduces necessary threaded connections from ten to three, the manufacturer claims. The valves, which combine unions, nipples, reducers, elbows, tees, valve and drain valve into one unit, are available in nine stylines which include valves with or without union outlet as well as offset and jacketed valves. One valve can be used to replace the multiple setup of valves and connections formerly used.

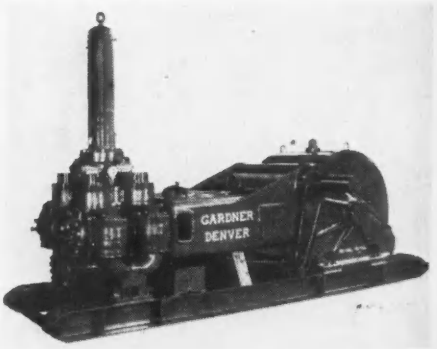
For additional information write Jerguson Gage & Valve Company, 80 Fellsway, Somerville 45, Mass.

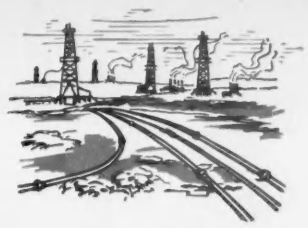
Slush Pump

This item supplements Gardner-Denver Company data on pages 1770-1777 of Composite Catalog, 17th Edition.

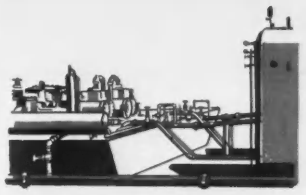
Engineering especially for deep hole drilling, a new power slush pump known as the GXR is a 7½ x 8 duplex power pump rated at 650 horsepower. The GXR has a one-piece, dust-proof main frame cast of GarDurloy alloy. Eccentric power end construction results in low bearing pressures, and double helical drive gears relieve main and jackshaft roller bearings of all thrust loads. Liquid cylinders are interchangeable between right and left hand positions, and are fitted with screwed valve pot covers. Working parts are readily accessible.

For additional information write Gardner-Denver Company, Quincy, Ill.

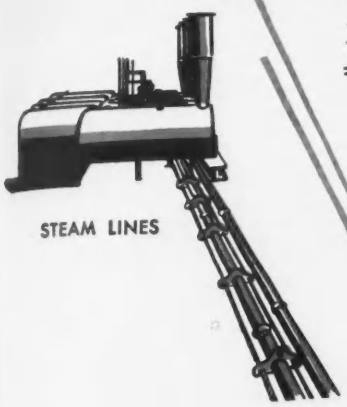




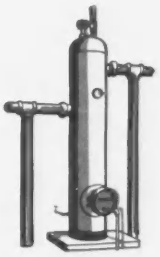
FIELD LINES



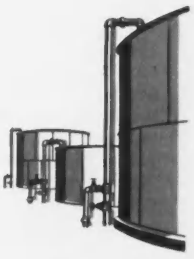
WATER LINES



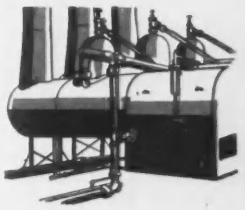
STEAM LINES



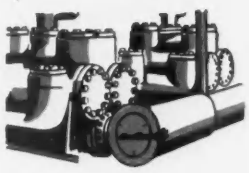
SEPARATORS



TANK BATTERIES

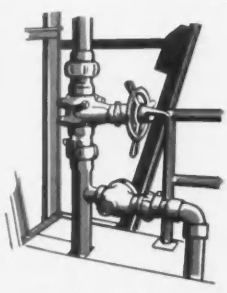


BOILER HEADERS

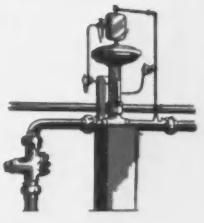


SLUSH PUMP
STRAINERS

XMAS TREES



MUD LINES



REGULATOR
MANIFOLDS

MAKE THE MOST OF A GOOD THING—UNIBOLT!

. . . the perfect coupling for drilling and production service

There is no limit to the uses for UNIBOLT Couplings in drilling and production service. Any line — steam lines, water lines, mud lines, oil and gas lines — can be coupled tighter, with a stronger joint, and dismantled and reassembled in fast time with UNIBOLT Couplings. Three types of seats: a metal ring gasket type for high pressure service, a renewable resilient type for saturated steam and low pressure oil, gas, or water lines, and a tongue and groove type which conforms to ASA-600 Series specifications for welding neck couplings. Hubs are provisioned for threaded, socket weld, or butt weld connections. The pressure range is up to 15,000 lbs. test.

So, you name the coupling job and UNIBOLT will furnish the coupling designed expressly for that job. Make the most of a good thing . . . UNIBOLT.

THORNHILL-CRAVER CO.

HOUSTON, UNIBOLT THE ONE BOLT COUPLING TEXAS

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

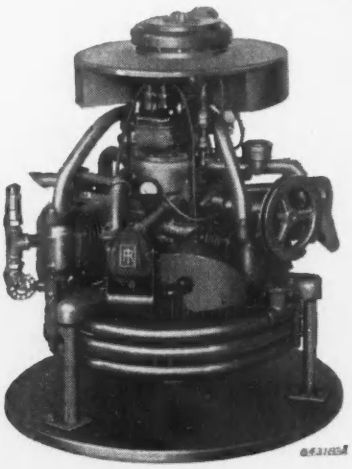
Compressor

This item supplements Ingersoll-Rand Company data on pages 2465-2472 of Composite Catalog, 17th Edition.

A compact gasoline-driven air power unit, the new 36 cubic feet per minute "Spot-Air" compressor weighs only 265 pounds, and stands only 32 inches high on a 27-inch diameter baseplate. It can be mounted on a special wheel barrow for easy portability.

A horizontal arrangement of three power cylinders and three air cylinders spaced alternately at 60-degree intervals around a vertical single-throw crankshaft convert engine power into air power without the need of a heavy flywheel. The four-cycle gasoline engine has overhead alloy steel valves with adjustable tappets. Exhaust valves, with Stellite seat inserts, are of the "free type" to allow rotation for longer valve life.

The compressor delivers 36 cfm at 80 pounds per square inch.



For additional information, write Ingersoll-Rand Company, 11 Broadway, New York 4.

Speed Reducers

This item supplements The Falk Corporation data on pages 1632-1633 of Composite Catalog, 17th Edition.

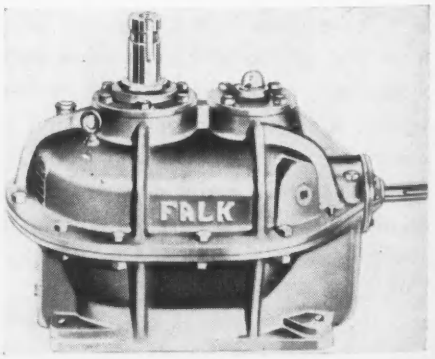
Power transmission requirements for almost every industry can be served by a line of speed reducers which includes both parallel shaft and right angle (both horizontal and vertical) types.

The standard speed reducers have herringbone double helical gears and are available with sleeve bearings or roller bearings. Right angle models have spiral bevel helical gears and antifriction bearings.

Parallel shaft speed reducers with sleeve bearings are capable of input speeds of 1750 and higher, with an approximate horsepower range of 15 to 2000. Parallel shaft reducers with roller bearings have similar speed range, and approximately horsepower range of 15 to 1500. Ratio range for each is 2.22:1 to 300:1.

Approximate horsepower range of right angle horizontal speed reducers is 15 to 1500 and ratio range is from 1.5:1 to 515:1. Right angle vertical speed reducers have approximate horsepower range of 15 to 1000, and ratio range of from 5.7:1 to 430:1.

For additional information write The Falk Corporation, 3027 West Canal Street, Milwaukee 8, Wis.



FIRST
IN CANADA'S
OIL FIELDS

Assets exceed
$2,334,000,000

Branches throughout Canada's oil-rich western plains. On-the-spot information available through E. B. Durham, Supervisor, Calgary, Alberta, or Head Office, Montreal

THE ROYAL BANK OF CANADA

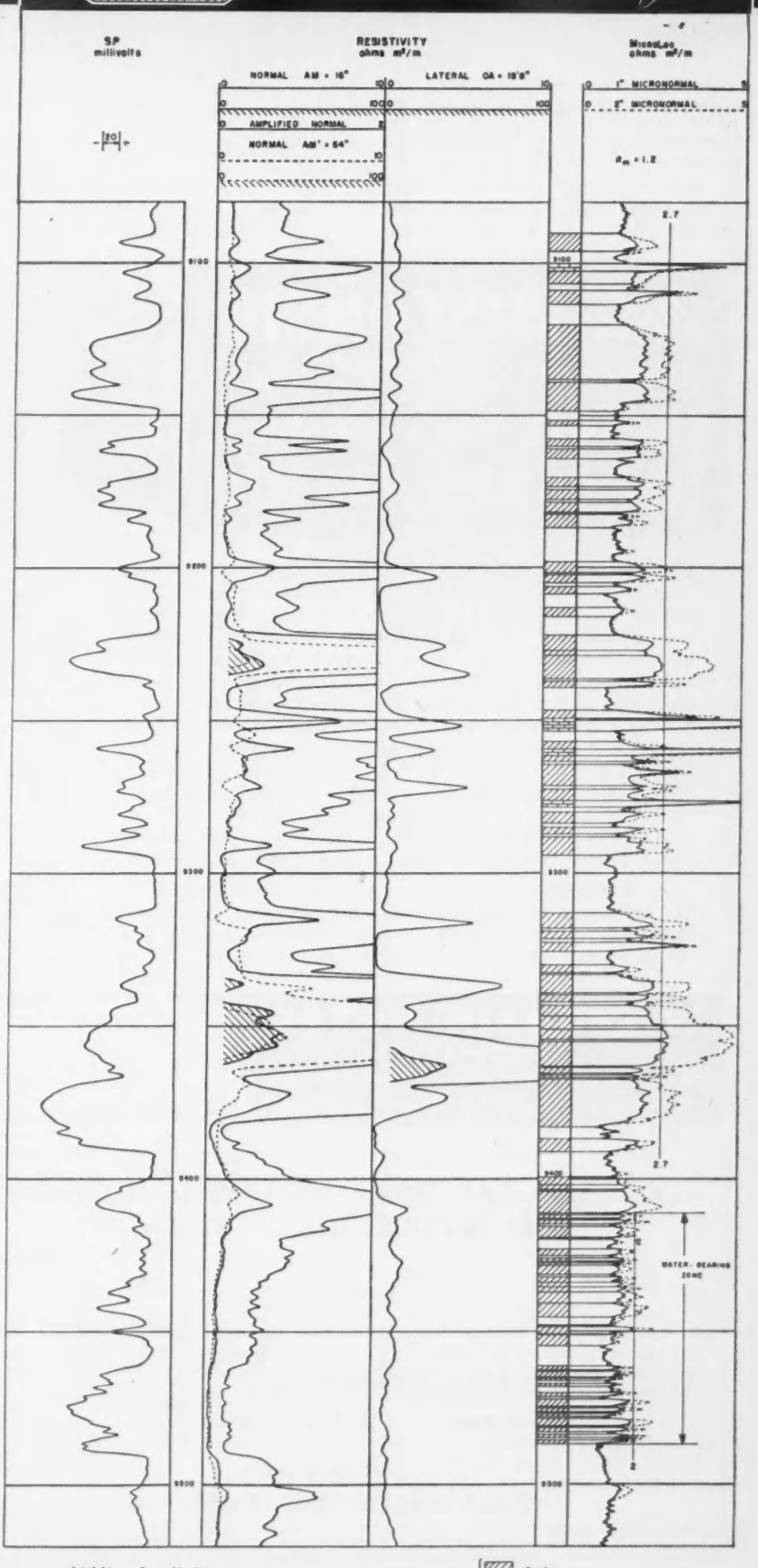
Over 750 branches in Canada and abroad

THE MICROLOG* IN UNCONSOLIDATED FORMATIONS

FRIO SAND
IN
POINT COUPEE PARISH
LOUISIANA

SCHLUMBERGER WELL SURVEYING CORPORATION
HOUSTON, TEXAS

Electrical Log



Mud (Caustic & Quebracho): R_m = 1.5 at B.H.T.
Bit Size: 9⅞"

Spacings:	Regular	"MicroLog"
	AM = 16"	Micronormal 1"
	AM' = 64"	Micronormal 2"
	AO = 18'8"	

The "MicroLog" is a record of resistivity measurements made with electrodes at short distances from one another applied to the wall of the bore hole. The influence of the mud column is practically eliminated by an insulated electrode support.

The "MicroLog" was developed for use in consolidated formations. It has proven to be an equally valuable tool for investigating unconsolidated sections. It provides a remarkably detailed record of the formations, in particular, of permeable porous strata with reservoir possibilities. It then permits a very accurate determination of the amount of pay section.

Three formation types with precise boundaries are illustrated. The regular electrical log complements the "MicroLog" in analyzing the types:

1) Shale—Indicated by low "MicroLog" values with a minimum of separation between the curves. Thin shale or sand laminations are further characterized by breaks in the microcurve.
2) Unconsolidated sand — Indicated by somewhat higher (than shale) "MicroLog" values, usually with a separation between curves. The longer micronormal value is normally the higher on permeable, porous strata.
3) Consolidated (Calcareous) sand streaks—Indicated by high "MicroLog" values. Such streaks should be eliminated in determining net pay.

The amount of separation between the curves depends on certain characteristics of the media and on bore hole conditions. Compare the section from 9410' to 9480' with the rest of the log. Conditions affecting the separation include:

1) Amount of shale in the sand and/or thickness of the sand-shale laminations.
2) Salt water versus oil sand. The curve with the longer spacing will normally show a higher value in oil sand because residual oil is present in the invaded zone.

The "MicroLog" confirmed sufficient section in this case to attempt a completion from 9289-93'.

PRODUCTION RESULTS:

Perforated:	9289 - 93'
Potential:	147 B.O.P.D.
Gas/oil Ratio:	497 - 1
Water:	30%

SCHLUMBERGER

SCHLUMBERGER WELL SURVEYING CORP.
HOUSTON

*"MicroLog" is a Trade Mark of the Schlumberger Well Surveying Corp.

OTHER NEW AND IMPROVED EQUIPMENT

Welder

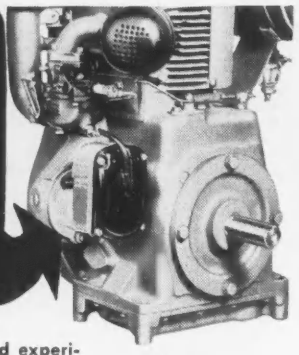
A new line of alternating current transformer welders has an arrangement whereby welding heat adjustment is accomplished electrically through an ac-dc reactor.

The transformer has conventional primary and secondary windings, plus an additional winding which supplies current through a rectifier to provide direct current for ac-dc reactor adjustment. There are no moving parts.

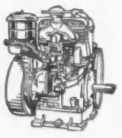
Available in 200, 300, 400, and 500 ampere sizes with stationary or portable mountings, these sets can be furnished for operation on single phase, 60 cycle supply current—either 220/440 dual voltage, 440/550, or 220/440/550 volts. They can also be furnished for 50 cycles.

For additional information write The Hobart Brothers Company, 1221 Hobart Road, Troy 1, Ohio.

Why WISCONSIN HEAVY-DUTY Air-Cooled ENGINES Have a Rotary-Type OUTSIDE MAGNETO



Wisconsin engineers have found through long experience and experimentation that the best place to put the magneto, not only for convenient accessibility but for better ignition performance over an extended period of time is on the OUTSIDE . . . with an independent, direct drive from the engine to the Magneto. The Rotary Type high tension magnetos used on Wisconsin Air-Cooled Engines provide the greatest protection against ignition troubles because the Magneto itself is a complete, independent operating unit that doesn't rely on an unrelated part of the engine for its successful operation. It's tightly sealed against dust and moisture, and there is no chance of it getting "fouled up." Oil field operators report that it is not unusual for big 80 to 100 hp. gas engines to run an entire year, 24 hours a day, with no repairs other than possibly a new set of points, when equipped with exactly the same type of magneto as used on all Wisconsin Engines.



Yes, the MAGNETO is important . . . both as to type and placing on the engine. It's the right kind and in the right place on Wisconsin Heavy-Duty Air-Cooled Engines. Specify "Wisconsin" for your 3 to 30 hp. power needs . . . Descriptive literature on request.

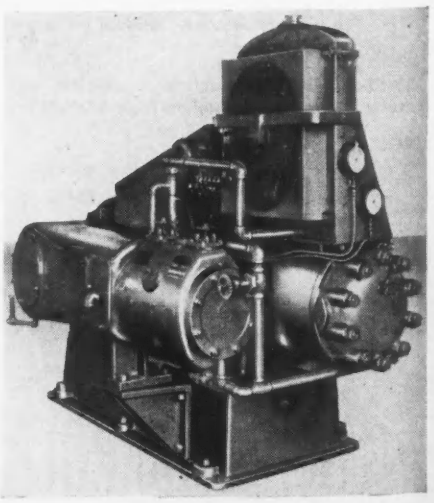
WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 ATLAS BUILDING, TULSA, OKLAHOMA
M & M BUILDING, HOUSTON, TEXAS
505 SOUTH MAIN ST., WICHITA, KANSAS
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.

Compressor Unit

A new unit for compressing natural gas or for use in the liquefied petroleum gas industry or other industry requiring gas under high pressure. Designated as the Lorain A-9 compressor, it is powered by a Lorain Model A multi-fuel engine. The single-stage compressor is driven through an overhung crankshaft. This arrangement reduces the 13-inch engine stroke to a nine-inch compressor stroke for high-pressure work and matches the compressor characteristics to engine horsepower output. The compressor cylinder has bottom discharge to prevent accumulation of gas condensates and is equipped with full force-feed lubrication, including lubrication of the metallic rod packings. The unit weighs 11,100 pounds with standard accessories.

For additional information write Mr. Ambrose, White-Roth Machine Corporation, Lorain, Ohio.



OIL AND GAS CONSERVATION, DEVELOPMENT AND PRODUCTION—A SUMMARY

By

PARK J. JONES

Dealing largely with optimum producing methods, this new volume is written for independent operators, drilling contractors, accountants, landmen, geologists, lawyers, schools and others who wish a non-mathematical discussion of the economic and physical factors entering into the development and production of oil leases.

Thirteen Chapters, 138 pages, 8¼ x 11, Many Tables and Graphs, Completely Indexed, Paper Bound, Price $6.00.

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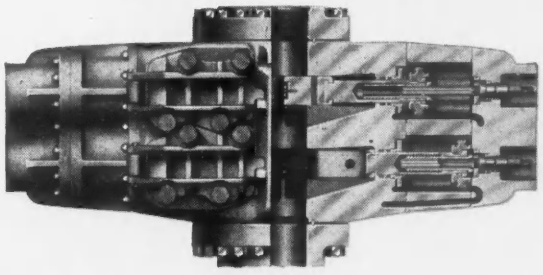
In cellar control gate equipment . . .

ONLY SHAFFER GIVES YOU BOTH

Hydraulic OPERATION



Shaffer Hydraulic Cellar Control Gates

If your operations call for *hydraulically*-operated cellar control gates, the Shaffer Hydraulic Cellar Control Gate is, by all standards, the most advanced, most dependable, most compact hydraulic cellar control gate available today. These are only a few of its many outstanding advancements . . .

▸ SPACE-SAVING COMPACTNESS: In the Shaffer Hydraulic Cellar Control Gate you get TWO separate ram compartments unitized in ONE body—*with a total overall height of only 30" even in sizes as large as 13⅜" (12" Series 900)!*

▸ COMPLETELY ENCLOSED DESIGN: Note how all moving parts are completely enclosed within the gate body—nothing to become damaged or wedged by objects falling into the cellar—nothing to become corroded by chemicals or salt-laden muds. Even the locking shaft is non-rising—fully protected!

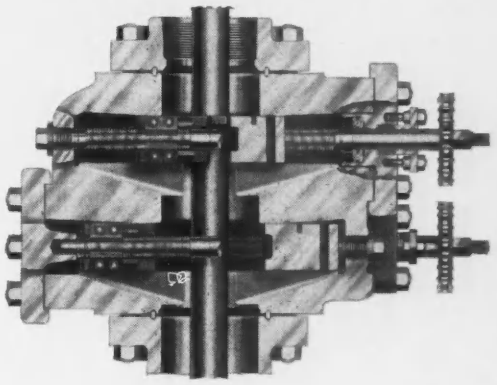
▸ FAST, SIMPLE RAM CHANGES—the simplest in *any* gate. Merely unbolt and swing open the side door, slide out the ram assembly, slide in the new assembly, close and bolt the door—and the job is done. *Moreover, complete ram changes can be made whether pipe is in or out of the hole!*

▸ DIRECT HYDRAULIC DRIVE with the hydraulic operating cylinders *directly behind* the rams. No secondary connections between hydraulic cylinders and rams—greater safety, maximum simplicity.

▸ QUICK DRAINING BODY: The rams travel on high narrow guide ribs far above the steeply-sloped compartment bottoms. Mud and sand quickly drain back into the well and no detrimental accumulations can collect to prevent free and complete ram travel!

The above advancements are vitally important—yet are only part of the COMPLETE *story on Shaffer Hydraulic Cellar Control Gates. Be sure to get* ALL *the facts from your Shaffer representative—or write direct!*

Mechanical OPERATION



Shaffer Double Cellar Control Gates

If your operations call for *mechanically*-operated cellar control gates, the Shaffer Double Cellar Control Gate is unequalled in this field. Maximum compactness, rugged dependability and installation simplicity are assured by such exclusive features as these . . .

▸ UNUSUAL COMPACTNESS: Although Shaffer Double Cellar Control Gates combine TWO complete ram compartments in ONE compact body, *they require less than 29" of cellar height even for sizes as large as 13⅜" (12" Series 900)!*

▸ WIDE CHOICE OF POWER: Shaffer Double Cellar Control Gates can be readily operated with air, steam or electric drive—all with the added protection of complete manual standby. Moreover, the same gate can be quickly changed from one type of power to another to fit the requirements of different rigs.

▸ SIMPLE RAM CHANGES: Only *one* end cover need be removed to completely change the rams in the compartment of a Shaffer Double Cellar Control Gate. The complete ram assembly slides out in one unit, facilitating ram changes and eliminating extra operations.

▸ SELF DRAINING BODY: The compartment bottoms in Shaffer Double Cellar Control Gates feature the same quick draining design as Shaffer Hydraulic Cellar Control Gates. Rams travel on high narrow guide ribs where no detrimental sand or mud accumulations can collect to interfere with free ram travel. Any mud or sand that does get into the compartment quickly drains back out again into the well, reducing maintenance to a minimum.

There are many other important operating features built into Shaffer Double Cellar Control Gates and your Shaffer representative will be glad to give you the complete details.

HERE'S AN ADDED SAVING! Not only are Shaffer Cellar Control Gates—whether hydraulically or mechanically-operated—the most advanced in their respective fields, but if you use *both* types in your field operations there is no need to stock separate ram blocks and ram rubbers for each type of gate. Ram Rubbers and Ram Blocks are interchangeable, size for size, between the hydraulically-operated and mechanically-operated Shaffer Cellar Control Gates. You save on inventory, minimize delays, simplify shipping and stock-room requirements.

Get an unbiased recommendation

on the type of cellar control gate best suited to *your* operations. Since Shaffer—and *only* Shaffer—manufactures both *hydraulically*-operated and *mechanically*-operated cellar control gates, Shaffer alone can provide you with either type of gate—depending upon which is best for *your particular* operations!

See pages 4433 to 4496 of your 1950 Composite Catalog for helpful data on the above equipment as well as on other Shaffer products.

Write for your free copy of the new Shaffer Catalog.

SHAFFER

27 years OF OIL TOOL LEADERSHIP

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

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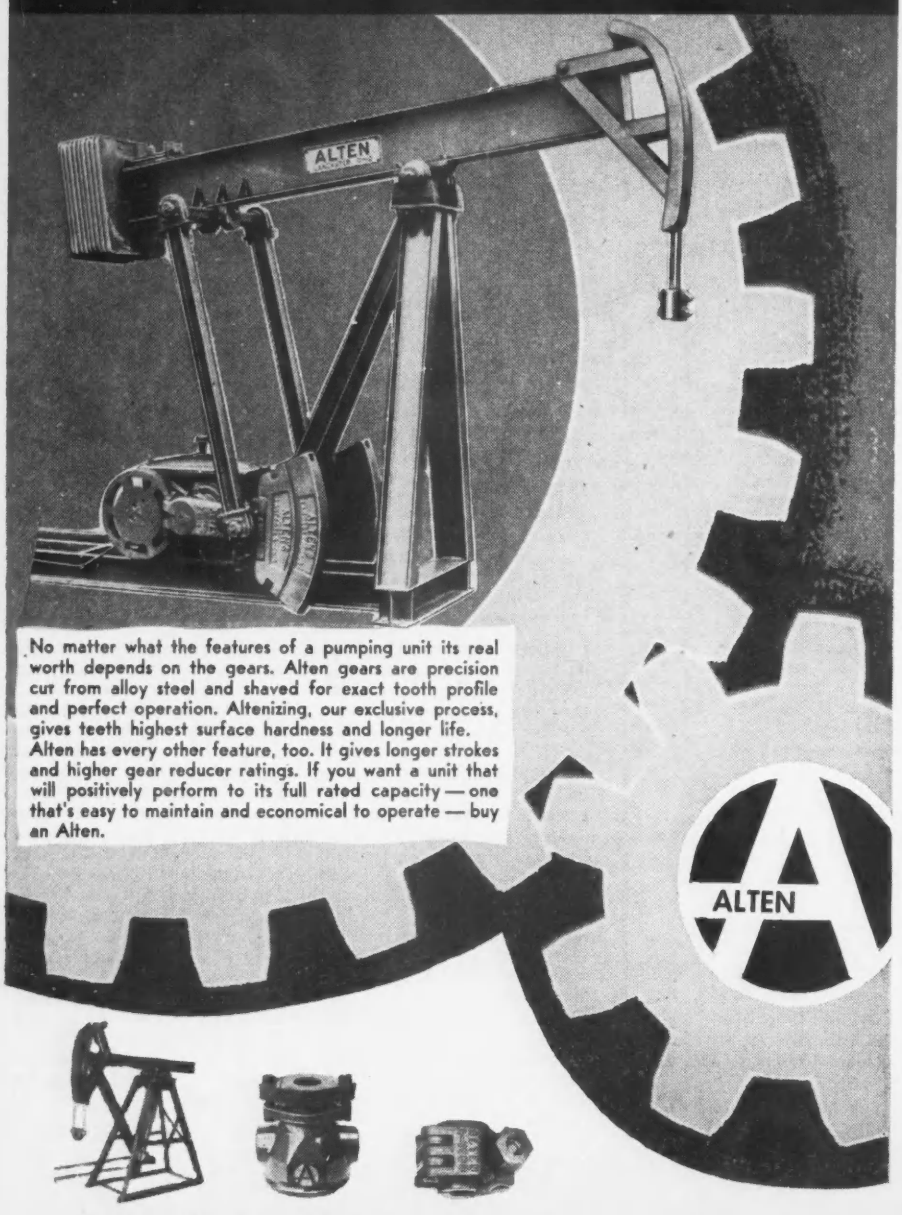
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

ALTEN

PUMPING UNITS ARE *Geared* FOR BEST PERFORMANCE



No matter what the features of a pumping unit its real worth depends on the gears. Alten gears are precision cut from alloy steel and shaved for exact tooth profile and perfect operation. Altenizing, our exclusive process, gives teeth highest surface hardness and longer life. Alten has every other feature, too. It gives longer strokes and higher gear reducer ratings. If you want a unit that will positively perform to its full rated capacity — one that's easy to maintain and economical to operate — buy an Alten.

ALTEN

PUMPING, SURFACE & FIELD EQUIPMENT

ASK FOR COMPLETE ALTEN LINE
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ALTENS FOUNDRY & MACHINE WORKS, INC.
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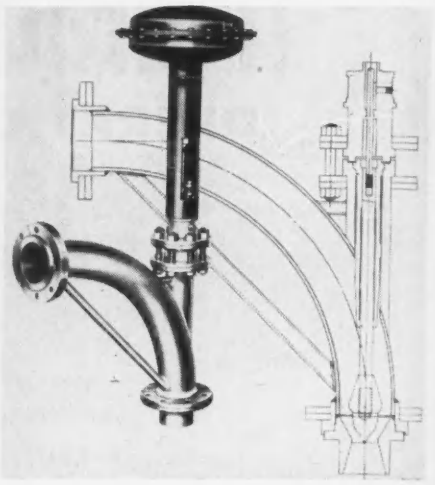
OTHER NEW EQUIPMENT

Angle Valves



The new 7000S Series Flo-Tested Long Sweep Angle Valves are designed primarily to produce minimum turbulence in the flow through the valve and for use on slurry service where the solids in suspension tend to plug the conventional control valve. Valve body is a long radius bend. It can be fabricated from any pipe which can be bent or welded. Plug valves are of the high lift type, normal lift being one-half the nominal valve size. The long sweep angle valves are available in sizes from 2- to 6-inch. The seat, designed as a section of a venturi throat, is one piece and is the retained type.

For additional information, write Hammel-Dahl Company, 243 Richmond Street, Providence, R. I.

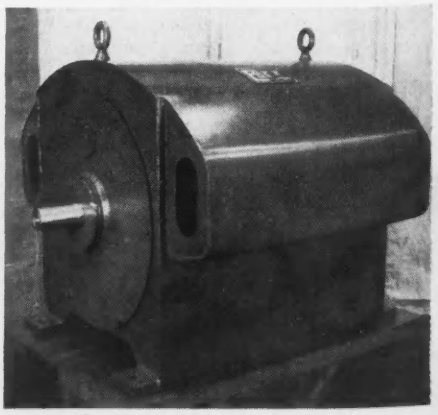
Splashproof Motors

Splashproof motors, suitable for installation out-of-doors without external protective covering, are available in either horizontal or vertical types.

The horizontal motor, illustrated, can be placed on a simple foundation or base of the driven machine. Its ventilating air inlet openings are on the sides of the motor and discharge between the feet, to provide a straight-through path for high-velocity wind and rain, thus bypassing the interior of the motor.

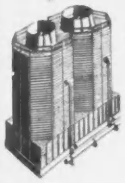
The vertical motor is normally mounted on top of vertical pumps, well up from the ground, to permit air intake through bottom of motor and side discharge.

For additional information, write Elliott Company, Jeannette, Penn.



OVER 250 TOWER COMBINATIONS FROM 258 PREFABRICATED PARTS

why Fluor can give you



THE RIGHT TOWER... AT THE RIGHT TIME... AT LESS ERECTION COST

Whatever your cooling problem—process, gas or liquid—Fluor has the cell size and height to meet flexibility and operating requirements. From only 258 standard interchangeable prefabricated parts, over 250 *different* tower sizes and arrangements are possible—the result of over 30 years' experience in the design and manufacture of cooling towers to solve virtually every cooling problem in industries utilizing water as a cooling medium.

Fluor is the largest manufacturer of prefabricated cooling tower parts in the world—Here's what this means to you . . .

THE RIGHT TOWER, *guaranteed* to meet your specified requirements. The octagonal shape, true counter-flow design and "Spirodome" upspray distribution system of a Fluor Counterflo Cooling Tower offer greater cooling capacity per square foot of ground area than any other type tower available!

AT THE RIGHT TIME means just that. From an in-stock supply of prefabricated parts, the tower meeting specified requirements can be "packaged" for immediate shipment. Your tower delivered this way gets fast freight handling and erection upon arrival.

AT LESS ERECTION COST because all parts are marked for fast erection. There's no need for trial-and-error or cut-and-fit erection methods. Another saving is realized by the elimination of scaffolding. Extra heavy grid decking supported on 2" x 4" cross bracing—a feature of all Fluor Counterflo Cooling Towers—form the only scaffolding necessary for continuous erection.

FOR YOUR FILES

"Cooling Tower Studies"

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"Evaluating Cooling Tower Performance"

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DESIGNERS AND CONSTRUCTORS of Refinery, Natural Gas and Chemical Processing Plants.
MANUFACTURERS of Mufflers, Pulsation Dampeners, Gas Cleaners, Cooling Towers and Fin-Fan Units.

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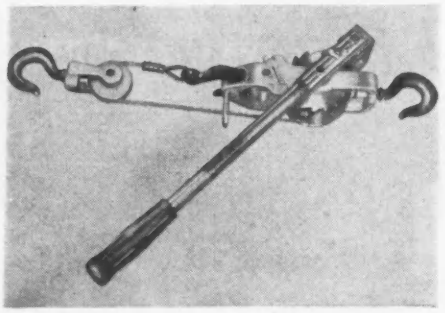
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.I., England

Portable Winch-Hoist

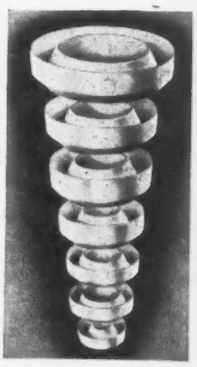
With a 30:1 power ratio and tested to a 100 percent overload, the new Lug-All 1½-ton alloy winch-hoist weighs only 8½ pounds. The tool has pre-formed flexible aircraft cable, stainless steel fittings and springs, and permanently oiled bearings. The handle is reversible and acts as a "safety valve" to protect the user. A combination of three swivel hooks and a built-in pulley block allows work to be done around corners and as close as ten inches at the ¾-ton rating. Locking is positive and automatic, and there is no brake to slip. The hoist can be operated in any position, and may be set for forward, reverse or free wheeling.



For additional information, write The Lug-All Company, 331 East Lancaster Avenue, Wynnwood, Penn.

V-Ring Packing

V-ring packings molded from Teflon combine the chemically inert and frictionless properties of Teflon with the resilience and toughness needed for proper sealing. Cross-section design insures permanent sealing, even under varying pressures, at temperatures up to 450° F. "Chemlon" V-rings are available in many stock sizes, or can be molded to suit requirements.



For additional information write Crane Packing Company, Department P-29, 1800 Cuyler Avenue, Chicago 13.

Paint Brush Safe

A sealed, air-tight, all metal paint brush safe designed especially for oil and gas industry use preserves paint brushes and keeps them in top shape. It also makes a compact, lightweight carrying case which can be locked.

Paint brushes are suspended to the correct depth in individual compartments holding paint solvent or preserving fluid. The safe has a waste-compartment with wringer attachment which extracts surplus paint or preserving fluid. Waste compartment is removable for draining and cleaning; and can be placed in any position. Movable brush clips in the individual storage compartments permit storage of brushes of varying dimensions. Each storage compartment is removable.

For additional information, write Y & N Manufacturing Company, Wooster, Ohio.

Type "XV" (Extra Volume) King Swivels

For Circulating Large Fluid Volumes

Be Sure IT'S A KING *Be Safe*

Type "XV" King Swivels are designed specifically for drilling conditions where the circulation of greater quantities of drilling mud is required than can be handled by conventional models of small swivels.

In addition to oversize watercourses, King Type "XV" Swivels provide many exclusive features that make them the first choice everywhere for Water Well Drilling, Geophysical Drilling, Working Over, Drilling Shallow Oil Wells, Core Drilling, Drilling in and Coring with Reverse Circulation.

Check these outstanding advantages you get with King Type "XV" Swivels:

- OVERSIZE WATER COURSES assure Large Fluid Volume.
- MOULDED RUBBER PACKINGS ELIMINATE the stuffing boxes.
- HARDENED WEAR-BUSHINGS eliminate the washpipes.
- THE PACKING AND WEAR-BUSHINGS can be renewed within a very few minutes without removing any other part from the swivels.
- ANGULAR-CONTACT BALL BEARINGS provide ample thrust capacity and insure radial stability.
- ALLOY STEEL CONSTRUCTION assures safety with minimum weight.
- SHORT, COMPACT DESIGN requires less room in the derrick.
- STREAMLINED—no projections to "hang up."
- CLOSED HOUSING PROTECTS THE BEARINGS.
- LUBRICATION, of BEARINGS, is by means of a grease gun.

This swivel fulfills a long felt need of the well drilling fraternity.

See your latest Composite Catalog for other King Oil Tool products.

KING OIL TOOLS

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EXPORT: R. S. STOKVIS & SONS, INC.

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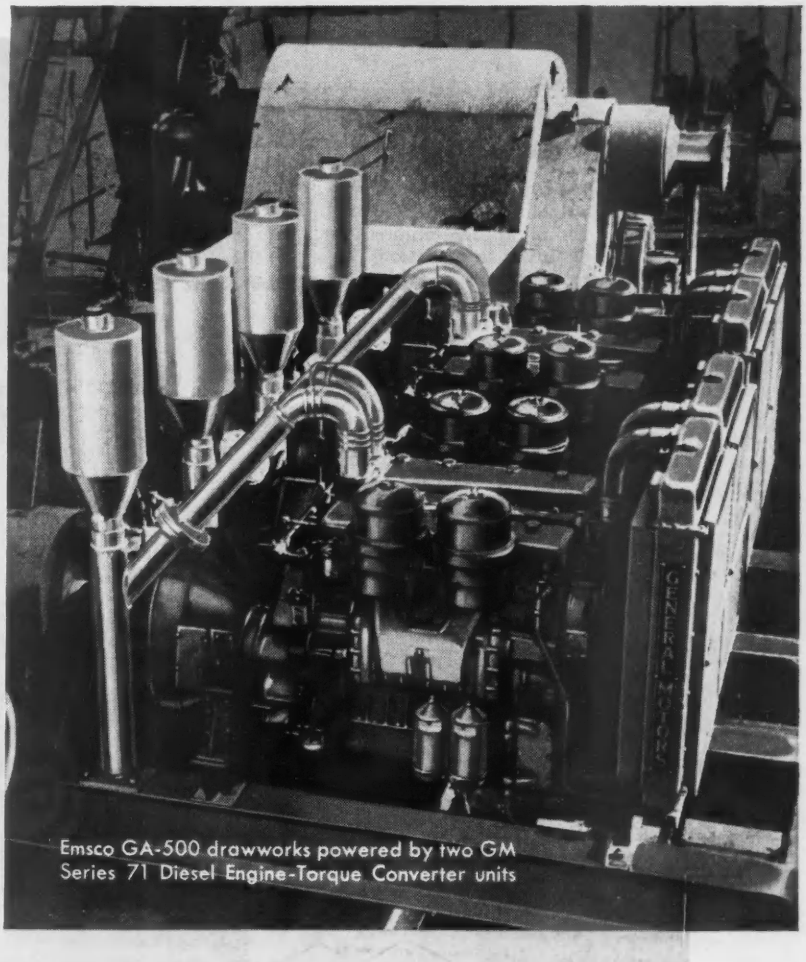
PULLED 53 STANDS in *52 Minutes!*



Emsco GA-500 drawworks powered by two GM Series 71 Diesel Engine-Torque Converter units

FOWLER Drilling Company, Long Beach, California, reports that this General Motors Diesel-powered Emsco rig pulled 4800 feet (53 stands and one single) of 4½" drill pipe and 4 drill collars in 52 minutes.

C. L. "Slim" Fowler, president, says *"Over two years ago, we also bought a National 50 drilling rig powered by two GM Diesel Twins and until only recently we spent nothing for repairs. Those engines are still running fine and have not been overhauled. That record plus the high output and easy moving convinced us."*

Drilling hole faster with GM Diesel power is a common experience among cost-wise drilling contractors everywhere. These high-speed 2-cycle Diesels pack more power in less space. This means fewer units; faster, lower-cost moves; quicker setups. They make faster round trips and—with readily accessible, interchangeable parts—they take less time off for service.

Discover how these efficient, lighter-weight, 2-cycle Diesels can cut your drilling costs. Get the story from your local GM Diesel distributor or write direct to us.

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES... *Up to 275 H. P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS... *Up to 800 H. P.*

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GM GENERAL MOTORS DIESEL POWER

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1504 Philtower Bldg., TULSA 3, OKLAHOMA

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Flexible Metal Hose

Data on flexible metal hose contained in Catalog 500 is compartmentalized so that cross-references and footnotes are eliminated. The first section gives information on flexible metal interlocking high pressure hose, air jacketed hose for diesel exhausts, and conveyor hose for ventilating and exhausting. The second section refers to flexible metal seamless high pressure hose and diesel exhaust hose. Section three is concerned with metal lined gasoline hose and synthetic rubber gasoline hose. Couplings applicable to the various hoses comprise the last section.

For a copy of this catalog write David M. Fuchs, Atlantic Metal Hose Company, Inc., 123 West 64th Street, New York 23.

Carbureted Engines

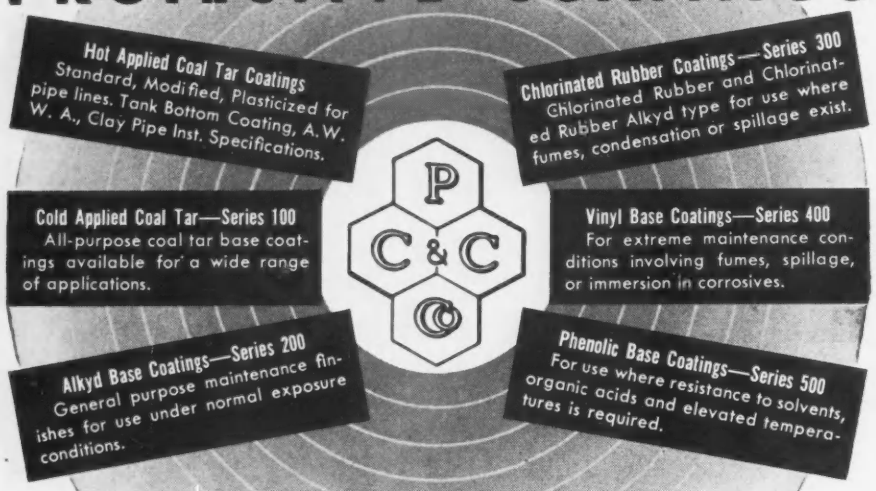
A new folder with specifications and on-the-job illustrations of carbureted engines is available.

For a copy of Form A-257-NN, write International Harvester Company, 180 North Michigan Avenue, Chicago 1.

Announcing

INDUSTRY'S MOST COMPREHENSIVE FAMILY OF

PROTECTIVE COATINGS


Hot Applied Coal Tar Coatings
Standard, Modified, Plasticized for pipe lines. Tank Bottom Coating, A.W.W. A., Clay Pipe Inst. Specifications.
Chlorinated Rubber Coatings—Series 300
Chlorinated Rubber and Chlorinated Rubber Alkyd type for use where fumes, condensation or spillage exist.
Cold Applied Coal Tar—Series 100
All-purpose coal tar base coatings available for a wide range of applications.
P
C&C
Vinyl Base Coatings—Series 400
For extreme maintenance conditions involving fumes, spillage, or immersion in corrosives.
Alkyd Base Coatings—Series 200
General purpose maintenance finishes for use under normal exposure conditions.
Phenolic Base Coatings—Series 500
For use where resistance to solvents, organic acids and elevated temperatures is required.

Here's a great new arsenal of weapons for fighting corrosion—a comprehensive family of top-quality protective coatings to stop this multi-billion dollar waster in its tracks. The Pittsburgh Coke & Chemical Company, a leader in the production of coal tar pipe line enamels, now offers you a wide selection of tough, impervious coatings for effectively checking corrosion—from atmospheric exposure to attack by strong chemicals, high temperatures, and other destructive factors.

Laboratory-controlled from basic raw materials to finished products, Pitt Chem protective coatings are completely uniform and dependable. With the aid of these modern coatings and Pittsburgh Chemical field engineering service, your Corrosion Engineer may be able to save you thousands of dollars this year through an effective corrosion control program. • Write today for any information or assistance you need.

Protective Coatings Booklet

Now Available

Booklet containing specific information on Pitt Chem Protective Coatings and our facilities will be sent upon request.

See Your Nearest Pitt Chem Man

PROTECTIVE COATINGS DIVISION

W&D 3390

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PITTSBURGH COKE & CHEMICAL CO.

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Centrifugal Pumps

Economical pumping units for many industries are cataloged in a new 16-page "Handy Guide to Selection of Centrifugal Pumps." A wide variety of units are indexed in this bulletin, including close-coupled, pedestal, double suction single stage, multi-stage, self-priming, fractional horsepower, coolant and circulating, fire, process, solids handling, marine, rubber-lined, axial and mixed flow pumps. Head capacity charts and tables for various types are given along with data on sizes, capacities and construction features.

For a copy of Bulletin 52B6059G, write Allis-Chalmers Manufacturing Company, 1063 South 70th Street, Milwaukee.

File Folder

The cover of a new file folder has full color illustration which depicts the installation and/or operation of about 30 Otis services, tools and equipment. The 9 x 12-inch folder fits standard cabinets and is intended to catalog folders, price lists, and other literature on Otis pressure control equipment and wire line services.

For a folder and literature, write Otis Pressure Control, Inc., Box 7206, Dallas.

Packings

Material on Palmetto packings, previously available in separate product bulletin sheets, has been included in a new 20-page illustrated catalog. Self-lubricating, molded and sheet packings, both standard and special, are covered in the detailed text.

For a copy of Catalog PC-101, write Greene, Tweed & Company, North Wales, Penn.

Air Locks

Air locks and trip master controls for holding regulating and control valves in position during failure of air supply are described in a new two-page bulletin. Printed in two colors, the bulletin is illustrated with photographs, diagrams and line drawings.

For a copy of bulletin S-31, write The Swartwout Company, 18511 Euclid Avenue, Cleveland 12.

Zinc Coating

Zincilate, a one-coat, self-protecting, anticorrosion coating is described in a new eight-page technical bulletin. The bulletin presents case histories, specifications, and data on application methods.

For a copy of this bulletin, write Industrial Metal Protectives, Inc., 401 Homestead Avenue, Dayton 8, Ohio.

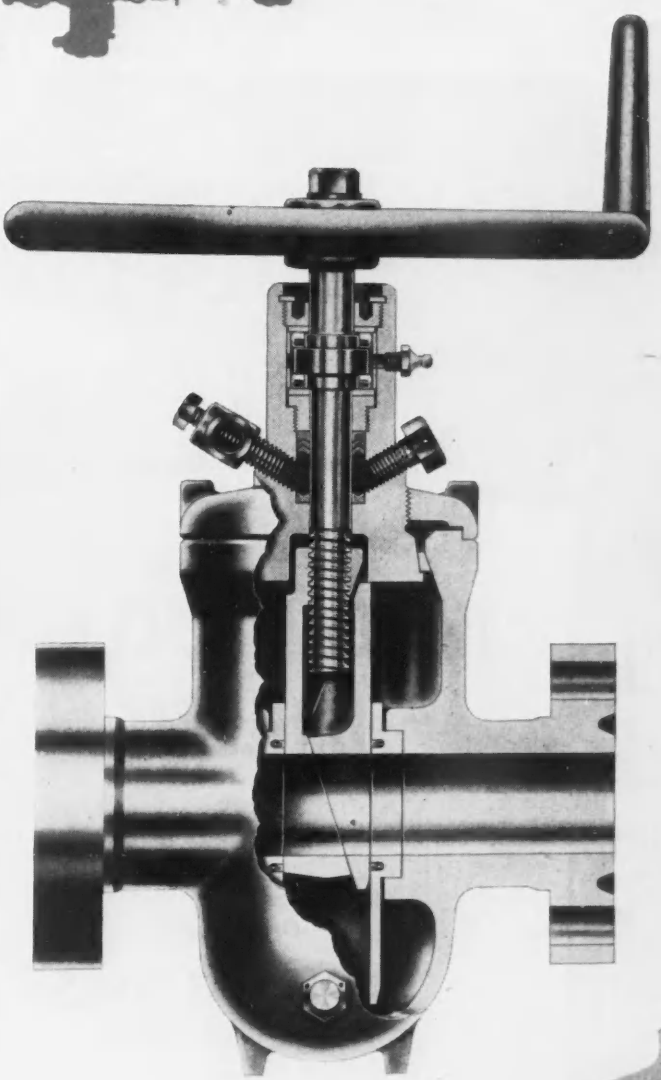
Universal Joints

Graphs on static torque tests, angle of operation efficiency curves, and frictional heat loss curves are included in a new catalog, C1, on Universal Joints. The catalog also contains other engineering data, specifications and price lists.

For a copy of this catalog, write Curtis Universal Joint Company, Inc., Birnie and Arch Streets, Springfield 7, Mass.

SAFETY IS THE KEYNOTE

OF DRILLING AND PRODUCTION OPERATIONS



SO PUT MASTER-GATE PROTECTION ALL OVER YOUR XMAS TREE CONTROLS WITH W-K-M GATE VALVES

Your well is most securely controlled by W-K-M Through-Conduit Gate Valves.

When you use W-K-M Master Gate Safety *all the way* . . . instead of some miscellaneous or supplementary gadget . . . the extra margin of safety that W-K-M Gate Valves provide gives you maximum safety and protection throughout your Christmas Tree controls.

This W-K-M *extra margin* of safety means the difference between safe and "half-safe" control.

Specify dependable W-K-M Gate Valves throughout on your Christmas Trees for maximum safety, service and economy. . . . for complete safety at every point of control.

In the long run, W-K-M Gate Valves are the most economical and by far the safest means of controlling high or low pressure wells.

W-K-M Company

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Pipe Line Pumps

"Pipe Line Pumping Units," a new eight-page booklet, describes pipe line power packages and tells the story behind the complete assembly of centrifugal pumping units for stationary or portable service.

For a copy of Form 30047, write Caterpillar Tractor Company, Peoria 8, Ill.

Pipe Line Services

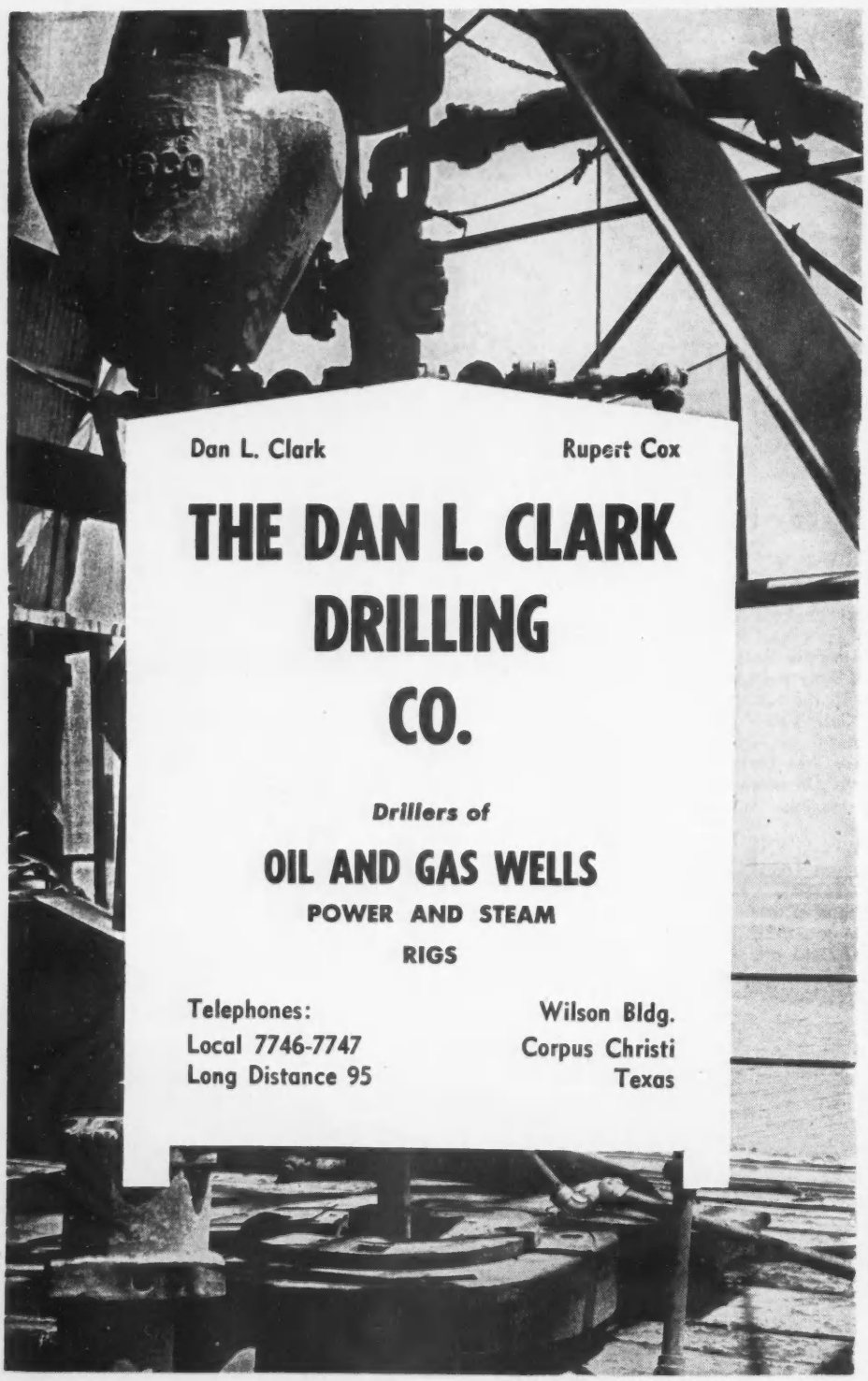
A new 70-page catalog illustrates pipe line equipment, materials and supplies, such as pipe cleaning and priming machines, pipe coating and wrapping machines, tar heating kettles, Vitron glass wrapper, internal lineup clamps, beveling machines, etc. Also included are data on coating and wrapping materials, mileage and quantity.

For a copy of this catalog, write M. J. Crose Manufacturing Company, Inc., Box 3368 Whittier Station, Tulsa.

Steel Hardening

"Methods To Be Used in the Preparation of Stainless Steel for Hardening," a new booklet by C. U. Scott, describes a process which gives a hard case of 68 to 73 transposed Rockwell reading, and is file hard at 1000° F.

For a copy of this booklet write C. U. Scott & Son, Inc., Rock Island, Ill.



Rubber Products

"Rubber Products for the Petroleum Industry" is a new booklet containing descriptions and prices of 12 different products for use in the petroleum field. It is a 20-page booklet adequately indexed and fully illustrated. Many types of rubber hoses are presented including air, steam, gasoline and oil hoses.

For a copy of this booklet, write Carlyle Rubber Company, Inc., 62-66 Park Place, New York 7.

Geared Pump Drives

Descriptions of right angle geared pump drives and their application to vertical turbine pumps is the subject of a comprehensive new bulletin, No. B-140-1. The bulletin describes the construction of the Peerless right angle gear head and includes sectional drawings and dimensions.

For a copy of this bulletin, write Peerless Pump Division, Food Machinery and Chemical Corporation, 301 West Avenue 26, Los Angeles 31.

Treaters

A new 16-page Treater Catalog contains two four-color flow diagrams tracing the emulsion flow of oil and gas through both the BS&B Standard "S" Treater and the newly developed, field-tested "J" treater. These two and their cold weather counterparts, the "JCW" and the "SCW" are described in detail, with complete specifications and capacities on all types and sizes.

For literature, write Black, Sivalls and Bryson, Inc., Advertising and Sales Promotion department, 7500 East 12th Street, Kansas City, Mo.

Diesel Engines

Series 600 diesel engines, which have a 12¾-inch bore, 15½-inch stroke, and a speed range from 360 to 625 rpm, are described in a new four-page bulletin, No. 321. The series includes both naturally aspirated and supercharged engines for stationary and marine service.

For a copy of this bulletin, write The Baldwin Locomotive Works, 940 Simpson Street, Eddystone 42, Penn.

Sucker Rods

National sucker rods for every field condition are described and illustrated in color in a new 16-page bulletin, No. 368. The bulletin covers three grades of sucker rods each recommended for certain load and corrosive conditions. It also includes specifications for hollow sucker rod couplings, pony rods, polished rods, and pull rods.

For a copy of the bulletin write The National Supply Company, Box 899A, Toledo, Ohio.

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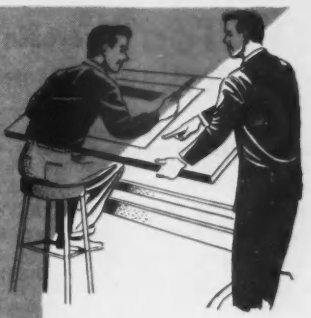

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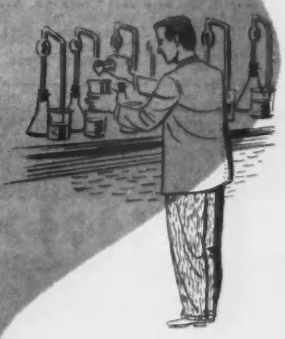
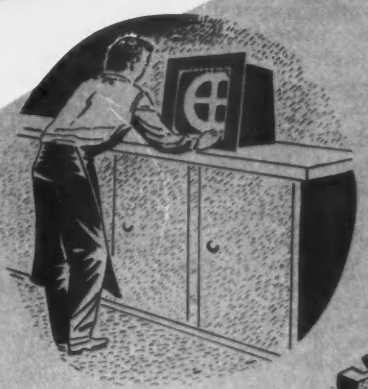
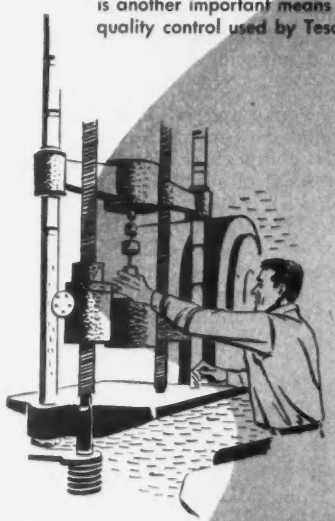
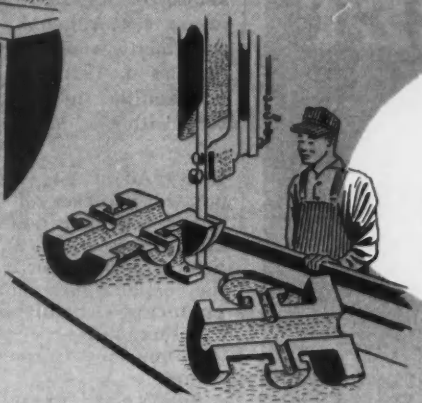




Radiographic examination is another important means of quality control used by Tesco.





By destructive laboratory examination, Tesco metallurgists keep a close check on the internal structure of the steel.

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Men in the Industry NEWS

Don Emery, a member of the board of directors, member of the executive committee and vice president and general counsel of Phillips Petroleum Company, has resigned his position as executive committee member and as vice president and general counsel to enter the private practice of law in Oklahoma City.

Emery will continue to serve as a director of Phillips Petroleum Company and as a director of American Independent Oil Company. Emery had been an employe of the company for over a quarter of a century and a director and officer since January 1, 1938.

Rayburn L. Foster, assistant general counsel, was elected vice president and general counsel of Phillips Petroleum Company to fill the vacancy created by Emery's resignation. Foster has over 22 years continuous service with the company.

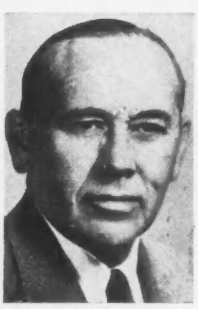
•

L. E. Bennett has been appointed general auditor of Standard Oil Company of California, succeeding **A. H. Kent,** retired.

Bennett, who joined Standard at Los Angeles in 1920, has been assistant general auditor since May, 1944. Kent had been with the company 33 years.

•

J. K. Adams of Houston has been appointed manager of Texas Eastern Production Corporation's Land and Lease department. Texas Eastern Production is the exploration and producing subsidiary of Texas Eastern Transmission Corporation.



J. K. Adams

Adams was formerly with Mills Bennett Production Company of Houston and other Mills Bennett organizations. He engaged in pipe line, production, and land and lease operations for these companies from 1929 to 1950. A graduate of Baylor University in 1923, he was a sales representative of the Timken Roller Bearing Company from 1925 to 1928. During World War II he served as a contracting officer in the Air Force.

•

Richard R. Linn, Oklahoma City attorney, has joined Continental Oil Company's legal staff there.

•

Edward C. Ritchey, formerly of Norman, Okla., has joined Kerr-McGee Oil Industries, Inc., Oklahoma City, as research chemical engineer.

•

Walter Berger and **Charles H. Pishny** have organized the consulting firm of Berger and Pishny, with offices on the ninth floor of the Commercial Standard Building, Fort Worth. Both are former members of the firm of Cummins, Berger and Pishny, and will continue to engage in consulting, valuations, and geological work.

John W. B. Foringer has joined Lion Oil Company as director of industrial relations. He will be in charge of all matters relating to personnel and labor relations, and will serve as director and administrator for Lion in union negotiations.

J. W. B. Foringer

A graduate of the University of Indiana Law School in 1931, Foringer was engaged in the general practice of law, usually connected with oil, until 1936 when he went with Owens-Illinois Pacific Coast Company, where he dealt with labor and personnel problems. From 1939 until 1947, he engaged in similar work for United States Steel Corporation subsidiaries, first with Carnegie-Illinois Steel Corporation and later with the United States Steel Supply Company. From 1947 until 1949, he served as vice president in charge of industrial relations of the Kansas City Power & Light Company. Since 1949 he has been a consultant in legal and financial matters.

•

Robert E. Kepke and **H. T. O'Neill** have been appointed directors of the newly formed Platte Pipe Line Company. Kepke is vice president of supply and transportation for British American Oil Company, Ltd., and O'Neill is B-A's vice president of finance.

B-A, together with four major U. S. petroleum companies, is participating in building the $60 million Platte crude oil pipe line from Wyoming to Wood River, Illinois.

Kepke is vice president of the British-American Oil Producing Company and the Toronto Pipe Line Company, B-A subsidiaries operating in the U. S. Both Kepke and O'Neill are directors of the Portland-Montreal Pipe Line Company in which B-A has a 20 percent interest.

•

George C. Grow, Jr., formerly geologist with the Peoples Natural Gas Company, has joined the Transcontinental Gas Pipe Line Corporation as manager of the Underground Gas Storage department, with offices at 1060 Broad Street, Newark, N. J.

John C. Papp has joined the corporation as a reservoir engineer. He was formerly with J. R. Butler & Company and The Carter Oil Company.

•

Harrison F. Carr, New Orleans district manager for United Gas Pipe Line Company and Union Producing Company, has retired and has been succeeded by **J. B. Storey,** who has been assistant district manager at New Orleans for nearly three years.

Carr had completed 23 years with the United Gas companies. Storey has been in the organization nearly 16 years. He was district geologist at Jackson, Miss., from 1941 to the end of 1947, when he became assistant district manager at New Orleans.

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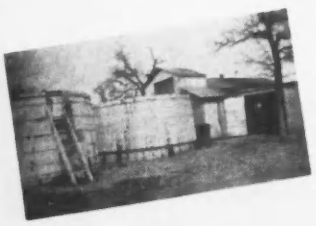

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MEN IN THE INDUSTRY NEWS

Stanley D. Smith, William H. Eckes, Arthur W. Neff and **Charles D. Grant** have joined the geological staff of American Trading and Production Corporation at Midland, Texas.

•

R. W. McCanne, assistant to the manager of production at Findlay, Ohio, has been appointed assistant manager of the Casper division of The Ohio Oil Company. **E. B. Stewart,** Tulsa division superintendent, has been named manager of the new Sidney, Neb., district. **R. C. Farley,** assistant to the general superintendent of production at Findlay, has been named Tulsa division superintendent succeeding Stewart.

The new Sidney district is within the Casper division, and has its headquarters in the area of the company's recent discoveries of oil and gas production in western Nebraska. The district includes Nebraska and adjacent portions of northeast Colorado and southern South Dakota.

McCanne was first employed by The Ohio in the Red Desert area of Wyoming during the summer of 1928 while he was a geology student at the University of Colorado. He rejoined the company as an assistant geologist folowilng his graduation in 1929. He was Casper division geologist from 1945-50, and was transferred to Findlay in February, 1950.

Stewart has been with the company since 1919, and has been Tulsa division superintendent since 1948.

Farley, who joined the company's Pipe Line department at Del Rio, Texas, in 1926, was appointed assistant to the general superintendent of production in 1949.

L. M. Swayze, who has been active as an independent oil lease broker in the Southwest since 1942, was appointed assistant to Deep Rock Oil Corporation's land manager **F. E. Swenson.**

Swayze came to Tulsa first in 1919 and was employed by the Producers State Bank. Later he entered land and lease work and went to south Arkansas just before the Eldorado field was discovered and joined the Humphries Oil Corporation. He returned to Tulsa in 1921 to work for the Red Bank Oil Company. In 1931 he embarked on his first tenure as an independent trader which lasted four years, then he joined the Fohs Oil Company in Houston, to head its land, lease and title work for seven years. He again entered the independent brokerage field in 1942 to operate in Louisiana, Texas and Oklahoma. In 1947 Swayze transferred his headquarters from Houma, La., to Tulsa.

•

Robert B. Shaffer, former engineer for Stanolind Oil and Gas Company at Levelland, Texas, has joined The Ohio Oil Company as petroleum engineer at Bakersfield, Calif.

•

James R. Cotton, former geologist for The Pure Oil Company, is now with Houston Oil Company of Texas in the Midland division office.

•

Carl B. Adam has been promoted to assistant director of the Safety division, Continental Oil Company, Houston.

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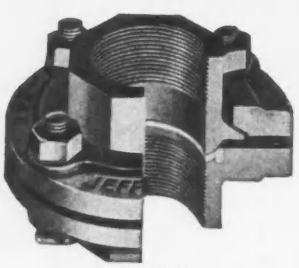

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R. R. Porterfield

S. C. Sanderson

R. R. Porterfield, formerly president of the Devonian Company, has joined Gulf Oil Corporation, Tulsa division, as manager of exploration. He had been with Devonian since 1925, when he was graduated from Stanford University, and served in various capacities before becoming president.

Other Tulsa division appointments include that of **S. C. Sanderson,** who has been named manager of exploitation. Sanderson joined Gulf in 1913 as a roustabout with the old Gypsy Oil Company. In 1921 he was named assistant superintendent of production, superintendent in 1929, and manager of production in 1945.

E. D. Loughney, former manager of the Accounting department and assistant secretary of the company, has been appointed executive assistant to **P. H. Bohart,** vice president. He joined Gulf in 1927 after receiving his B.S. degree in business from the University of Oklahoma.

Alexander W. McCoy III has been appointed chief exploration geologist, Tulsa division. He received his degree in geology from the University of Oklahoma in 1940 and joined Deep Rock Oil Corporation as a geologist. Later he was employed by The Carter Oil Company and Phillips Petroleum Company, serving as district geologist in the Rocky Mountain area prior to his new appointment.

J. E. Bounds has been named manager of accounting, Tulsa division, and **W. T. Grummer,** assistant manager. Bounds, who has been in the Tulsa division since 1929, was made assistant manager of accounting in 1945. Grummer has been in the department since 1936.

In the Production department staff in Pittsburgh, **R. C. Frederick** has been appointed chief of the Gas Supply and Disposition branch, with **Carl J. Maki** as his assistant. Frederick joined Gulf as a clerk in the Executive department, Tulsa Production division, in 1927, and until his new appointment was staff assistant to Bohart.

Maki was originally employed by the Mene Grande Oil Company, a Gulf subsidiary, in 1945 to form the Gas department, and has been superintendent of that department in Eastern Venezuela until his new appointment.

Merlin J. Johnson has been transferred from the Tulsa Production division to Pittsburgh as a statistician in the Gas Supply and Disposition branch.

Charles E. Lane has succeeded **W. F. Lund** as an assistant treasurer and in charge of the company's Insurance department. Lund will continue as a consultant. Lane has been with Gulf since 1916.

Dan B. Courville has been named assistant division production supervisor at Fort Worth for Gulf.

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Gerald J. Kathol and **Warren E. Tomlinson** have opened geological consulting offices at Wichita, Kansas.

•

E. S. Calvert has been elected president and member of the board of directors of the Devonian Company, Tulsa, succeeding **R. R. Porterfield**, resigned. **Miss Helen M. Egan** was elected assistant secretary and assistant treasurer, succeeding **H. E. Geiger**, retired.

•

Joseph E. Rakaskas has been named district geologist for Cities Service Oil Company, succeeding **W. V. Hess** who resigned to become a consultant.

Gilbert Wood, Jr., formerly with Phillips Petroleum Company, and **J. Whitney Mason**, formerly with Baroid Sales Division, National Lead Company, have formed a partnership, Oil Field Consultants, specializing in reservoir engineering, evaluations and mud engineering, with offices in the Leonhardt Building, Oklahoma City.

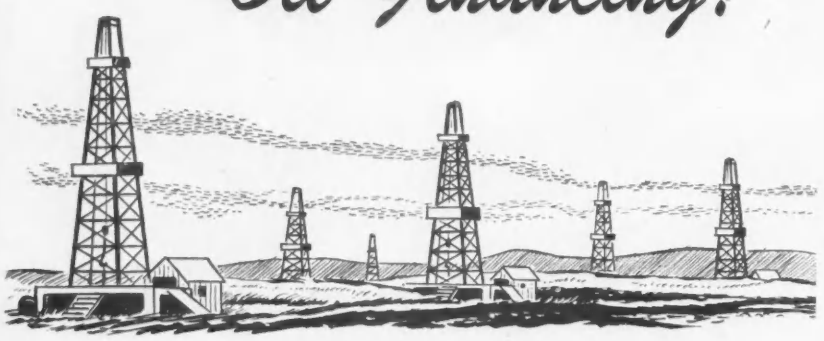
•

Charles Leet has been elected director of Interstate Oil Pipe Line Company, succeeding **Cecil Morgan**, resigned.

•

William Henry Cleveland has retired as tax supervisor for Tide Water Associated Oil Company, Tulsa, after concluding 30 years' service with the firm.

Thinking of Oil Financing?



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Captain Robert H. Meade, CEC, U. S. Navy, has been named director of Naval Petroleum Reserves. He succeeds **Commodore W. G. Greenman** who was assigned to other duties in the office of the Secretary of the Navy.

•

S. G. Snyder, for 28 years an employe of Skelly Oil Company, has retired as superintendent of the Pipe Line department in Kansas. He is succeeded by **George E. Ault**, who was promoted from assistant superintendent.

Mark V. White was promoted to assistant superintendent, with headquarters at El Dorado, Kansas. **J. M. Johnson** was named district foreman of the Cunningham-Burrton-McPherson district, replacing White.

•

Jack Shaughnessy, formerly of Tacoma, Wash., has joined The Pure Oil Company as oil scout in Casper, Wyo., succeeding **Forrest Daniels**, promoted to the land department.

•

John F. Fennelly has been elected a director of Anderson-Prichard Oil Corporation, succeeding the late **Charles F. Glore.**

•

Hiram J. Carson, formerly vice president in charge of operations, has been advanced to first vice president of Northern Natural Gas Company. He is succeeded as vice president in charge of operations by **Joe T. Innis**, formerly superintendent of operations, who will be in charge of the Pipe Line, Compressor, Dispatching, Measurement, Engineering and Construction departments.

John M. Hanley was named vice president in charge of gas supply, and **Myrven L. Mead**, company rate engineer, was elected assistant to the president.

•

F. M. Willenburg, Service Pipe Line Company, has been promoted from assistant division manager, Shawnee, Okla., to East Texas division manager, Fort Worth, succeeding **John J. Hill**, retired.

•

B. C. Pruet has been named Rocky Mountain division scout for Lion Oil Company, succeeding **Tom Clifton**, promoted to landman.

•

L. E. Harrington and **John R. Lynn**, formerly on the geological staff, The Carter Oil Company, have resigned and opened consulting offices at Lewistown, Mont.

•

John Wold, formerly Wyoming district geologist, Sunray Oil Corporation, Casper, Wyo., has resigned to become a consultant at Casper.

•

Dr. Robert Scholten has joined Sohio Petroleum Company as research geologist for Montana with headquarters at Casper, Wyo.

•

William D. Morris, Fort Worth, has resigned as secretary-treasurer of J. C. Maxwell, Inc., and Fort Worth Drilling Company, Inc., to devote full time to his duties as president of The Whaley Company, Inc.

MEN IN THE INDUSTRY NEWS

H. H. Arnold, Jr., of Denver, division manager, Rocky Mountain division, Producing department, The Texas Company, has been promoted to assistant to manager, Producing department, and will be located at Houston.

Tom T. Freeman has been advanced from assistant division manager to division manager, Rocky Mountain division, succeeding Arnold.

S. A. Berthiaume, senior geologist, manager's staff, has been appointed assistant division manager, Rocky Mountain division, and transferred from Houston to Denver.

•

Robert M. Wiggins, Seaboard Oil Company, has been promoted from general scout to landman at Midland, Texas, and **Carl S. Schreinder, Jr.**, has joined the company's scouting staff.

•

Wayne Granger, formerly development geologist for Standard Oil Company of Texas, has joined Brinkerhoff Drilling Company at Midland, Texas.

•

W. K. Howard has resigned from the geological staff of The Carter Oil Company and is now a consulting geologist at Mt. Carmel, Ill.

•

Dan McCauley and **Sam Marie** have resigned their positions with Sterling Oil and Refining Company to enter the consulting field, with offices at 1015 Electric Building, Houston.

•

Charles Allen has been placed in charge of the Mid-Continent headquarters of William Ross Cabeen & Associates, engineers and geologists, in the Colcord Building, Oklahoma City. Cabeen general offices are in North Hollywood, Calif.

•

John V. Melton, formerly chief scout for The Atlantic Refining Company at Tulsa until two years ago when he joined British-American Oil Producing Company, has been named manager of the company's Central division with headquarters in Oklahoma City.

•

Tom Ockershauser has resigned as petroleum engineer, Globe Oil and Refining Company, to become a consultant with offices in Oklahoma City.

•

John H. Zanetis and members of his family have organized the Zanetis Oil Properties with headquarters at Lawrenceville, Illinois.

•

Joseph G. Lambert, formerly petroleum engineer, Stanolind Oil and Gas Company, at Cody, Wyo., joined the Chase National Bank, New York City, as evaluator of oil properties.

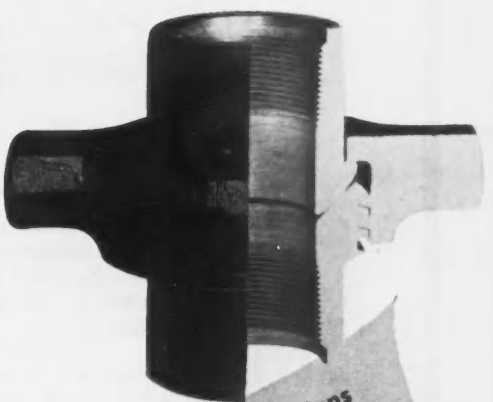
•

W. O. White, Shreveport, has resigned as executive vice president of Ormond Corporation to become president of the newly-organized Kenilworth Oil Corporation.

You can't beat the WECO FIG. 400

You just can't beat the Fig. 400 for versatility around the drilling rig. Designed for the tougher services required on mud, steam, water, oil and gas lines . . . lines that are made-up and broken-out most frequently . . . that carry abrasive fluids at high pressure with lots of vibration . . . the Fig. 400 withstands more abuse than any comparable union in these services. It makes-up fast, breaks-out quickly . . . seals perfectly every time with just a few hammer blows. The thicker wall sub ends resist distortion . . . give it greater strength with less weight.

Standardize on WECO Fig. 400 for the best connections in drilling and production service. Available in sizes 2" through 10"; 4000 lb. test pressures. All parts interchangeable.



Specify Weco Unions when ordering from your supply store.

WELL EQUIPMENT MFG. CORP.

Subsidiary of Chiksan Company
HOUSTON 1, TEXAS
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea, Calif. Chicago 3, Ill. Newark 2, N. J.
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. Newark 2, N. J.

WECO

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

DEATHS

William B. Goldey, European manager for Lucey Export Corporation, died in London November 27. He had been with Lucey Manufacturing Corporation and Lucey Export since 1913.

•

Walter M. Williams, 74, retired general superintendent of Cities Service Oil Company at Barnsdall, Okla., died December 2. He had retired in January, 1950, after 34 years.

•

Otto Peter Jacobsen, 68, drilling contractor, died November 21 in Tulsa. Before starting his own business, he was lease foreman for Barnsdall Oil Company, production superintendent for Waite Phillips, and worked for the Reserve Development Company.

Frank J. Itts, 54, assistant supervisor of employment for the Youngstown district of The Youngstown Sheet and Tube Company, died December 3 in Youngstown, Ohio. He had been with the company since 1923.

•

T. W. Tutwiler, 71, director of Cities Service Company since 1930 and a member of its executive committee, died November 9 in Birmingham. He held offices and directorships in many important business and industrial organizations.

John W. Kelley, 54, chief special investigator for the Texas Mid-Continent Oil and Gas Association, died November 8 in Dallas. Credited with having participated in tracking down more oil field thieves than any other man in the Texas petroleum industry's history, Kelley had a hand in the conviction of about 300 rustlers who preyed on oil operators, stealing equipment ranging from a few tools to complete derricks and truck loads of pipe. He had been with the association since 1937.

John W. Kelley

•

Maco Stewart, 54, independent oil man, lawyer and philanthropist, died December 16 in Galveston. President of Stewart Petroleum Company, he also headed the Stewart Title Guaranty Company. Stewart was chairman of the board of the Guaranty Federal Savings and Loan Association, chairman of the board of Gulf Marine Ways, director of the American National Insurance Company, and director of the News Publishing Company of Galveston.

•

Walter Henry Aspin, 85, pioneer Oklahoma drilling contractor, died October 12 in Tulsa. He entered the oil business at Titusville, Penn., and moved to Oklahoma in 1911.

•

Harry C. Minard, 56, representative of Ajax Iron Works, died October 17 at Midland, Texas.

•

Dudley G. Bolton, 79, for many years branch manager for Fairbanks, Morse & Company at Dallas, died November 1. He had joined the company in January, 1906, and retired several years ago.

•

K. C. (Tommy) Tomlinson, manager of American Meter Company's Pacific Meter Works, died November 14. He joined American Meter in 1926.

•

Willis Barton Smith, 60, production foreman for Amerada Petroleum Corporation at Odessa, Texas, died November 7 in Prescott, Ariz.

•

Harry J. Gibbons, 38, chief production engineer for Skelly Oil Company, died November 8 in Tulsa. A graduate of Oklahoma University, he joined Skelly in 1937.

•

Earle T. Miller, 64, Tulsa independent oil man, died November 13. He had been in semi-retirement since 1942.

•

Theodore Gothier Quintal, 39, counsel for Socony-Vacuum Oil Company, Inc., New York, died November 9. Quintal, a graduate of Yale Law School, joined Socony-Vacuum in 1946.

•

Albert Finston, 51, Mid-Continent independent operator of Tulsa, died November 24 near Eufaula, Ala., while en route to Florida. He was a former vice president and general manager of Bell Oil and Gas Company and served as a colonel in the Army supply service during World War II.

For HEAVIEST DUTY
PARAFFIN SCRAPING

- NEW DESIGN
- GRIP OF STEEL
- LONGER WEARING

More strength, wearability, and holding power here! The new M-25 S-I-W Paraffin Scraper hugs the rod with as much as 5000 pounds of GRIP! It stays put!

Field installation, with special S-I-W tools, is easy. The new M-25 has a super rugged design. Two heavy steel blades curl around the two shell halves to which they are welded. They exert continuous unplugging effect with every pumping stroke.

Check these big M-25 features: easy field installation . . . maximum effectiveness . . . reasonable cost. The new S-I-W M-25 scraper is a bear for wear . . . a profit-saving paraffin control tool!

Sunshine Iron Works

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Companies in the News

WARREN OIL CORPORATION has transferred its North Central Texas division from Wichita Falls to Abilene.

•

DANCIGER OIL & REFINING COMPANY, a Delaware corporation, has been merged with Southern Production Company, Inc., a Delaware corporation, with Southern Production Company, Inc., as the surviving corporation.

•

INTERNATIONAL PETROLEUM CONSULTANTS, LTD., a geological, engineering and management service, has been organized with headquarters in the Petroleum Consultants Building, Pasadena, Calif. **Florent Houlding Bailly,** long a geologist and petroleum engineer in Venezuela, heads the group of specialists in geology, surface and subsurface petroleum engineering, petroleum chemistry, geochemistry and economics.

Other members are **John F. Dodge,** petroleum engineer and consultant and past chairman of the division of Petroleum Engineering at University of Southern California; **Dr. Rene Engel,** past curator of mineralogy and petrology, Los Angeles County Museum, consulting geologist, geochemist and engineer; **Dr. Hans E. Thalmann,** petroleum geologist, stratigrapher and micropaleontologist; **Charles R. Dodson,** professor of petroleum engineering at the University of Southern California; and **James B. Christie,** engineer and patent counsel of Pasadena, Calif.

Bailly was made president of Pantepec Oil Company of Venezuela and its companion company, Pancoastal Oil Company, C.A., of Venezuela, in 1949. He also organized four service companies which are under the technical direction of International Petroleum Consultants: Petroleum Engineering Associates and Oil Properties Consultants of Pasadena; Petroleum Industry Consultants, C.A., Caracas, Venezuela; and Geological Engineering Consultants of Cuba.

Construction is now under way on a new two-story and basement addition to the Petroleum Consultants Building, which will house the organizations.

Members of International Petroleum Consultants, Ltd., pictured at the ground-breaking of their new offices, are, left to right, Christie, Engel, Dodson, Bailly, Thalmann and Dodge.

CATAWISSA
DOUBLE UNION SWING CHECK VALVE "502"

FULL OPENING FOR 100% UNOBSTRUCTED FLOW!

COMPACT!
EFFICIENT!
ECONOMICAL!
EASILY ACCESSIBLE!

flow line and pipe line type for general oil country use in either horizontal or vertical position!

CATAWISSA Double Union Swing Check Valves are designed and recommended for rough and ready demands of oil country applications — for use in lines where no stop is installed close to the check valve and where pipe cleaning mechanisms (go-devils) are used. They are FULL OPENING, furnished with Catawissa PERFECT SEAL Unions on both ends, eliminating the use of a full union and nipple necessary to install regular type check valves! Can be easily cleaned or repaired on the line — with check holding line contents!

REFAX METAL BODIES
HITENSILOY WORKING PARTS
★
500-lbs. SERVICE O.W.G.
1500-lbs. TEST
250-psi WSP
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SIZES 2" to 4"

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OIL WELL SUPPLY CO.
Branches Serving All Oil Fields

WRITE FOR FREE CATALOG 11 SHOWING THE COMPLETE CATAWISSA LINE

CATAWISSA VALVE & FITTINGS COMPANY
60 MILL STREET ★ CATAWISSA, PENNA.

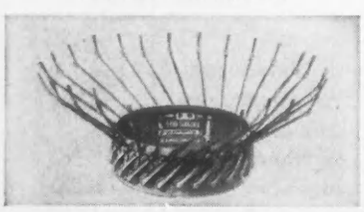
B and W SCRATCHERS AND CENTRALIZERS FOR A GOOD CEMENT JOB

B and W LATCH-ON CENTRALIZERS

with the NEW KON-KAVE BOW

and

B and W Multi-Flex Scratchers



are a GOOD Combination for a GOOD CEMENT JOB!

B and W Incorporated

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Long Beach 7, California, Long Beach 4-8366
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Houston 12, Texas, Phone: WEntworth 6603

Associations

Dallas-Fort Worth AAODC Names McClusky Chairman

W. L. McClusky, M. J. Delaney Company, Dallas, has been elected chairman of the Dallas-Fort Worth Chapter of American Association of Oilwell Drilling Contractors. He succeeds F. W. Brigance, Rowan Drilling Company, Fort Worth. C. D. Smith, McQueen & Clevenger, Fort Worth, was elected vice chairman of the chapter and Kye Trout, AAODC, Dallas, was elected secretary and treasurer.

Southwest Areas Discussed At Joint Exploration Meeting

Approximately 1200 geophysicists and geologists recently attended a two-day Joint Regional Exploration meeting at Fort Worth, Texas, to study mutual problems arising in certain Southwestern areas chosen because of the difficulties experienced in mapping possible oil-bearing structures. The meeting was under the auspices of the Society of Exploration Geophysicists and the American Association of Petroleum Geologists. Those in attendance heard 18 papers related to problems encountered in the Delaware Basin, Marfa Basin, Northwestern Shelf Area, Anadarko Basin, Plainview Basin and the Sabine Uplift and surrounding basins.

J. L. Morris, The Pure Oil Company, president of the Fort Worth Geophysical Society, presided. Ira H. Cram, vice president exploration, Continental Oil Company, Houston, delivered the principal address, entitled, "Let's Drill More Wildcats."

Stanolind Man Will Head East Texas Chapter of API

W. M. Jones, Stanolind Oil and Gas Company, Longview, Texas, has been elected chairman of the East Texas Chapter of API.

Other chapter officers are W. A. Holland, East Texas Engineering Association, Kilgore, Texas; C. R. Stevens, Humble Oil & Refining Company, Gladewater, Texas; and J. A. Williams, Jr., The Texas Company, Gladewater, all vice chairmen. Secretary-treasurer is Frank Folger, Stanolind, Longview, and assistant secretary-treasurer is W. G. Sole, Magnolia Petroleum Company, Kilgore.

The chapter has voted to continue its scholarship for a student graduating from Kilgore College to attend two additional years of engineering work at Texas A. & M. College.

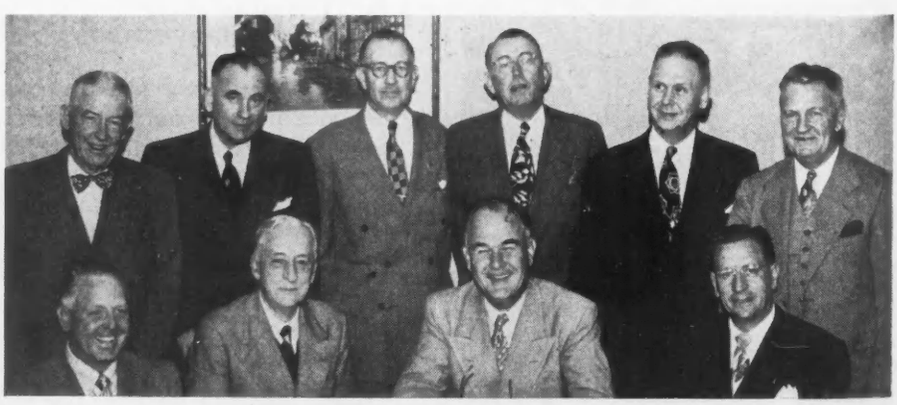
Landmen's Association Names Hunter Houston Group Leader

A. D. Hunter, Humble Oil & Refining Company, has been elected president of the Houston Landmen's Association. Vice president is Gerald E. Faust, Magnolia Petroleum Company and J. S. Abercrombie interests. Dave O. Fretz, Union Oil Company of California, was named secretary, and H. J. (Sonny) Roberts, Gulf Oil Corporation, was elected treasurer.

Directors of the Houston group are O. L. James, Fidelity Oil & Royalty Company; Lavon Gunter, The Texas Company; Frank J. Margeson, Shell Oil Company; L. B. (Buddy) Gatewood, Standard Oil Company of Texas; and E. Porter Johnson, Sun Oil Company.

Radio Engineers to Meet

The next Southwestern Institute of Radio Engineers conference will be held April 20-21, on the campus of Southern Methodist University, Dallas. The conference will be sponsored jointly by the Dallas-Fort Worth Section of the IRE, and the IRE Student Branch at SMU.



The Nomads National Board of Regents is pictured at its annual meeting in Los Angeles. Front row, left to right, are J. C. Basehart, The Buda Company, Dallas-Fort Worth; H. M. Cosgrove, executive secretary, Board of Regents, Tulsa; Fred C. Ripley, Jr., International Derrick & Equipment Company, Los Angeles, secretary-treasurer, Board of Regents; and Lee J. Laird, Gil-Lair Company, Los Angles. Second row: Edmond L. Lorehn, Cameron Iron Works, Houston, alternate for Ed. M. Fontaine; Brad Mills, AAODC, Dallas-Fort Worth; Val R. Wittich, Jr., export sales, New York; C. F. (Bud) Vincent, Byron Jackson Company, Houston, alternate for C. B. McDonald; H. M. Cooley, Bethlehem Steel Company, Tulsa; and A. V. Simonson, New York, export sales, alternate for Russell D. Heath.

ASSOCIATIONS

Los Angeles Engineer-Lawyer Elected 1951 ASME President

J. Calvin Brown, engineer and patent attorney of Los Angeles, has been elected president of The American Society of Mechanical Engineers for 1951, to succeed James D. Cunningham, Chicago. A mechanical engineer and attorney at law specializing in patent, trademark and copyright litigation, Brown has been a member of ASME since 1928.

Regional vice presidents elected are Henry Reginald Kessler, manager, Republic Flow Meters Company, New York; Stephen Dewey Moxley, vice president, American Cast Iron Pipe Company, Birmingham; Dr. John T. Rettaliata, dean of engineering, Illinois Institute of Technology, Chicago, and Carl J. Eckhardt (re-election), professor of mechanical engineering and superintendent of utilities, University of Texas, Austin.

Two Are Named to Vacancies On Georgia Oil Commission

L. B. Harrell, Waycross, Ga., and John Duncan, Jr., Brooks County, have been appointed to fill vacancies on the Georgia Oil and Gas Commission occasioned by the death of Judge Harry D. Reed and the resignation of T. Ross Sharpe.

Until oil or gas is found in commercial quantities in the state the primary task of the Commission is to encourage the drilling of exploratory wells. The state is offering a bonus of $100,000 for the first commercial well.

Texas University Fellowships Awarded by Petroleum Groups

Petroleum industry fellowship and research grants totaling more than $25,500 to the University of Texas were accepted by the University board of regents.

Texas Mid-Continent Oil & Gas Association sent the University Bureau of Business Research $2500—the first installment of a $7500 grant for an economic survey of the natural gas industry, with special reference to Texas.

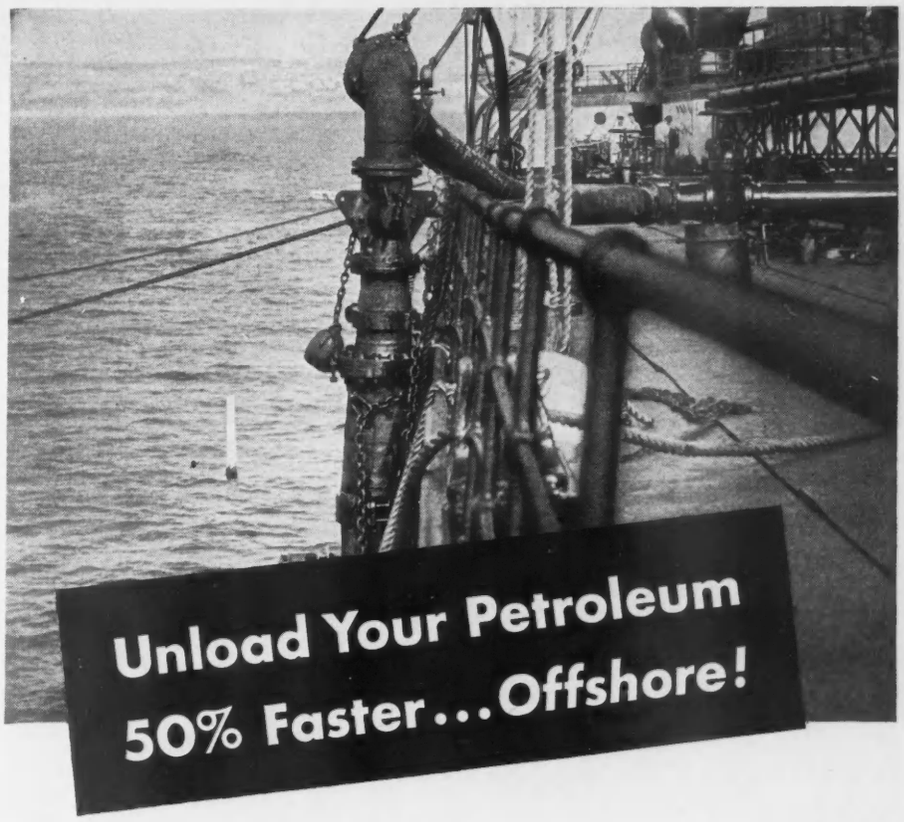
Oil company awards were given by Humble Oil & Refining Company, The Texas Company, Magnolia Petroleum Company, Pan American Refining Corporation, Shell Oil Company, Stanolind Oil and Gas Company and Ethyl Corporation. For its petroleum industry training program the University's Industrial and Business Training Bureau received $2960 from AAODC.

Golden Trend API Elects Book

C. C. Book, superintendent, Republic Natural Gas Company, has been elected chairman of the Golden Trend Chapter, API. Vice chairmen include H. K. Bourke, Warren Petroleum Company; W. S. McCrady, Phillips Petroleum Company; Max Marstand, Continental Supply Company; G. G. McKenney, Dowell Incorporated. W. W. Wylie, Schlumberger Well Surveying Corporation, is secretary-treasurer.

1951 Beaumont Meeting Set

Texas Mid-Continent Oil & Gas Association will hold its 1951 annual meeting October 8-9 in Beaumont, Texas.



Where there aren't dock facilities, there are serious problems—especially for hose. Service is long-haul, pressure terrific, flexing constant. On the inside is a procession of petroleum products, on the outside are salt water and sand—all of them capable of imposing serious damage.

The Hewitt-Robins brand on Sea Loading and Submarine Hose protects you against all these conditions.

FIRST, you will find faster flow—assured by its smooth bore; there's no coil of wire to set up turbulence. Flow is as much as 50% faster—a given size will carry 70%-90% of the carrying capacity of rough-bore hose 2" larger.

NEXT, is cleanliness—no wire ridges to collect sediment; solids are easily flushed through. Each product comes through cleaner—no corrugations retain the previous fluid.

FINALLY, there is much longer life. A high-tensile bead-wire reinforcement gives strength to withstand tremendous pressures—yet assures ample flexibility to withstand constant flexing. Its extremely tough and thick cover is unharmed by constant submersion and the abrasion of rolling over sandy ocean bottoms. This cover cannot strip. Nor will the smooth-bore tube pull out; it's bonded securely to the carcass and cured to the nipple to prevent leakage.

For fastest off-shore delivery at lowest cost, specify Hewitt-Robins Monarch® Sea-Loading and Submarine Hose. Write Hewitt Rubber Division, 240 Kensington Ave., Buffalo 5, New York, or Export Dept., Hewitt-Robins Inc., 370 Lexington Ave., New York 17, N. Y. Cable address: HEWRUB, New York.

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SEA LOADING AND SUBMARINE HOSE

HEWITT-ROBINS HR **INCORPORATED**

AIR HOSE • BARGE LOADING HOSE • FIRE HOSE • FLOATING ROOF TANK DRAINAGE HOSE
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STEAM HOSE • TRUCK TRANSPORT & TANK CAR DISCHARGE-SUCTION HOSE • TANK TRUCK HOSE
WATER HOSE • PROPANE-BUTANE HOSE FOR HANDLING LIQUEFIED PETROLEUM GASES
CONVEYOR BELTING • PIPE SLINGS • RUBBERLOKT® WIRE WHEEL BRUSHES

O. C. Bailey, chairman of the Arkansas Oil & Gas Commission, is shown (right) congratulating R. E. Patrick, second from left, upon his election to the presidency of the Petroleum Electric Power Association. Others in the photo are T. E. Graham (left), vice president, and Ned W. Beaudreau, secretary-treasurer.

Kansas Utilities Executive Is Elected PEPA President

R. E. Patrick, Kansas Gas & Electric Company, Wichita, Kansas, was elected president of the Petroleum Electric Power Association during the association's 22nd annual meeting at Hot Springs, Ark. Other new officers are T. E. Graham, Oklahoma Gas & Electric Company, Oklahoma City, vice president, and Ned W. Beaudreau, Central Power & Light Company, Corpus Christi, Texas, secretary-treasurer.

New directors selected for two-year terms include D. S. Coffman, Texas Power & Light Company, Dallas; R. N. Crossman, Houston Lighting & Power Company, Houston; Jim Moody, Southwestern Gas & Electric Company, Shreveport; Graham, and J. W. Lambert, Southwestern Public Service Company, Borger, Texas.

Next year's convention will be held in Houston.

Three Tulsa Oil Men Honored

Three prominent Tulsa oil men have been awarded life membership in the Mid-Continent Oil and Gas Association, an honor accorded to only 25 during the life of the organization. Receiving the honor were W. L. Connelly, retired chairman of the board, Sinclair Oil and Gas Company; Rush Greenslade, retired vice president, Tulsa division, Gulf Oil Corporation; Donald Campbell, retired general counsel, Sinclair Oil and Gas Company.

Wyoming Geologists Elect

John R. Fanshawe, Seaboard Oil Company, was elected president of the Wyoming Geological Association, Casper, Wyo. First vice president is John R. Miller, Pacific Western Oil Corporation; second vice president, F. A. Thurman, The Pure Oil Company; secretary, Helen Mann, Continental Oil Company; and treasurer, M. D. Hubley, Stanolind Oil and Gas Company.

Shreveport Scouts Elect

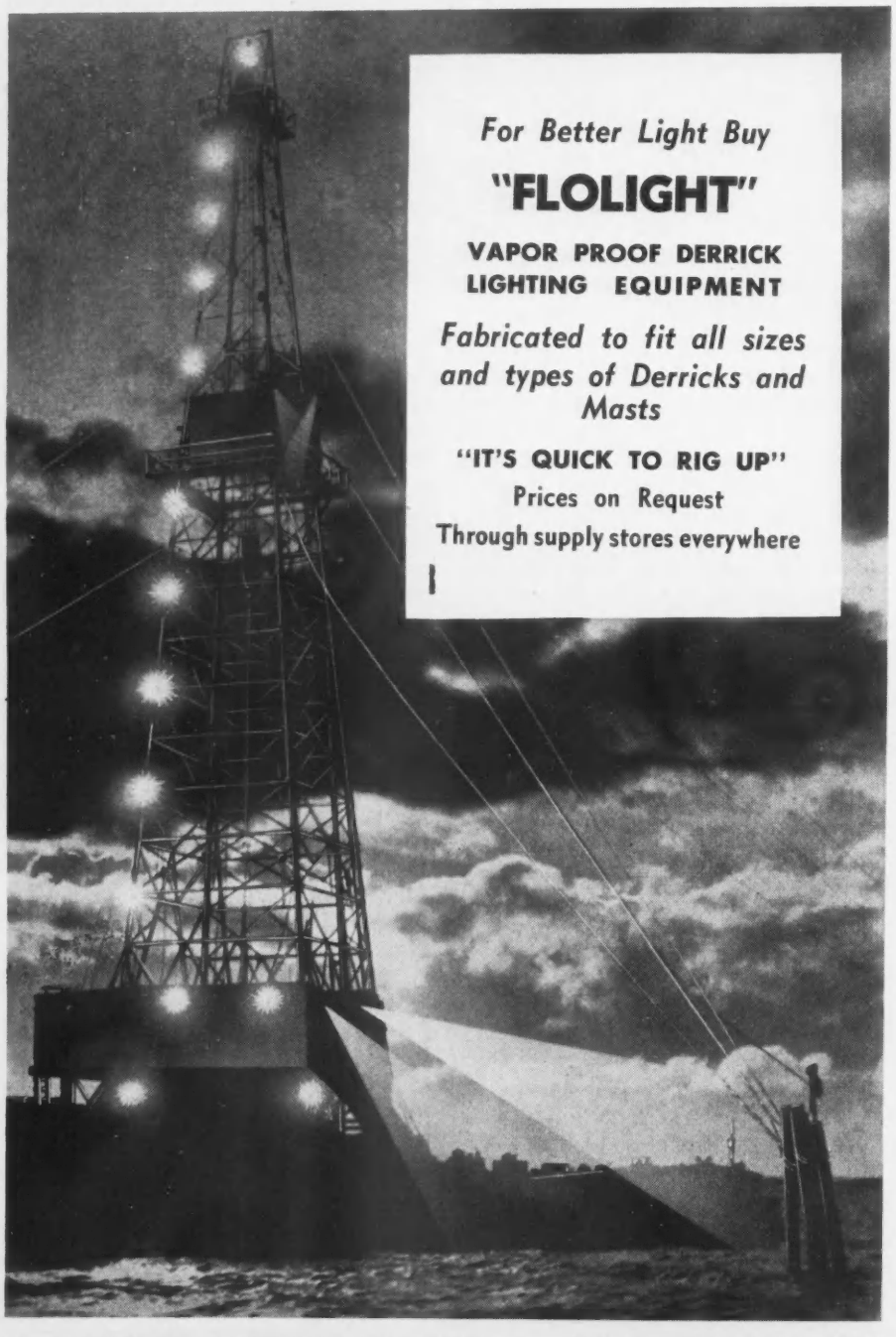
J. P. Williams, The California Company, has been elected president of the Shreveport Oil Scouts Association, succeeding W. N. O'Roark, The Carter Oil Company.

Penn Grade Names Field Man

Richard J. Cook of Oil City, Penn., has been appointed Midwest field service representative for the Pennsylvania Grade Crude Oil Association, with headquarters in Chicago.

IPAA to Meet in May

The mid-year directors meeting of the Independent Petroleum Association of America will be held May 7-8 at the Cosmopolitan Hotel in Denver.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"FLOLIGHT"
VAPOR PROOF DERRICK LIGHTING EQUIPMENT
Fabricated to fit all sizes and types of Derricks and Masts
"IT'S QUICK TO RIG UP"
Prices on Request
Through supply stores everywhere
HUTCHISON MANUFACTURING COMPANY
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ASSOCIATIONS

Natural Gas Association Elects Kayser President

Paul Kayser of Houston was elected president of the Independent Natural Gas Association of America at a board of directors meeting in Houston. Kayser, who is president of El Paso Natural Gas Company, succeeds Clyde H. Alexander of Dallas, president of the Creslenn Oil Company.

Other association officers are C. P. Rather, Birmingham, Southern Natural Gas Company, first vice president; and John F. Merriam of Omaha, Northern Natural Gas Company, second vice president.

Liquefied Petroleum Gas Men Name West Coast Secretary

Appointment of Richard W. Dorst as west coast secretary of the Liquefied Petroleum Gas Association was announced by Howard D. White, executive vice president. He succeeds K. B. Jacobsen, resigned.

A 1945 mechanical engineering graduate of the University of California, Dorst received a master's degree at Harvard Business School in 1948. Later that year, he entered the employ of Dewey and Almy Chemical Company, Cambridge, Mass., as a sales engineer and he subsequently became assistant to the overseas vice president. During World War II, he was an officer in the U. S. Navy.

Gulf Oil Employe Heads Up Tulsa Cost Accountants Group

Edward D. Loughney, Gulf Oil Corporation, Tulsa, was elected president of the Tulsa Chapter, National Association of Cost Accountants. Other officers are Carl J. Senger, Warren Petroleum Corporation; Robert P. Bryarly, Orbit Valve Company, vice presidents; Isham P. Nelson, Sand Springs Home, Sand Springs, secretary; Carl Joseph Nash, Nelson Electric Manufacturing Company, treasurer.

Also elected as directors were Orville R. Buttram, National Bank of Tulsa; Elmer L. Gallery, H. C. Price Company, Bartlesville, Okla.; M .L. Overstreet, Hotels Service Company; Robert Neil Page, International Business Machines; Harold H. Reed, Peat-Marwick-Mitchell & Company; Harold O. Reyburn, Nicholson, Reyburn & Company; T. L. Peterson, Loffland Brothers; Erwin A. Schroeder, Dowell Incorporated; Otto J. White, Price, Waterhouse & Company.

AGA Names Personnel Chairman

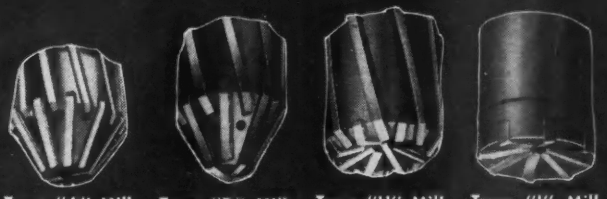
Dwight S. Sargent, personnel director, Consolidated Edison Company of New York, Inc., has been appointed chairman of the American Gas Association Personnel Committee, it was announced by D. A. Hulcy, president of AGA.

Committee Co-Chairmen Named

W. S. Norman, Magnolia Petroleum Company, Oklahoma City, and Glen R. Ames, Phillips Petroleum Company, Tulsa, have been chosen co-chairmen of the Oklahoma Oil Industry Information Committee for 1951.

KINZBACH Whipstocks and Mills-FIRST with oilmen for 24 years

Leading oil operators the world over use Kinzbach Whipstocks for side-tracking, straightening and directional drilling operations. They can be set at any depth, requiring no support for the bottom. Positive setting slips prevent slipping or turning in hole. They can be oriented to mill out in any direction. Patented hinge arrangement assures that top of Whipstock will lie close against pipe walls at all times, permitting easy passage of drilling tools. Setting trigger always locates whipstock between couplings so window will be within one joint. Available in all popular sizes of casing.



Type "A" Mill Type "D" Mill Type "H" Mill Type "I" Mill

Carefully heat-treated high-speed tool steel inserts from the cutting blades in Kinzbach Milling Tools. These inserts, set at most efficient cutting angles in properly shaped, high quality steel bodies provide unequalled cutting action and a uniform depth of cut.

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Export Office:
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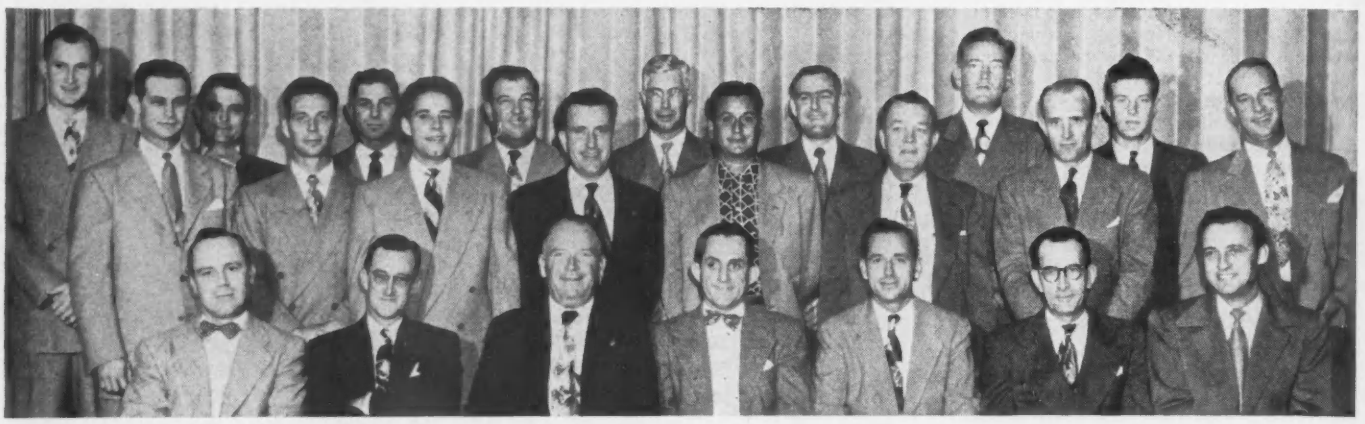
New York, N. Y.

EQUIPMENT AND SERVICE SUPPLIERS' NOTES



Oil Center Tool Company's annual sales meeting, held recently in Houston, was attended by O-C-T sales representatives from Louisiana, Oklahoma and Texas. In the group above, left to right, rear, are C. T. Jones, C. L. Braswell, R. L. Gammill, C. R. Sinclair, R. L. Cloninger, A. C. West, Jr., C. B. Wright, Jr., J. A. Clay, Ira C. Wells, M. E. Hunter, E. G. Amundsen, H. C. Stewart, A. M. Taylor, J. C. Norton, M. Davenport, and T. J. Dacy; front row, G. U. Berg, Jr., W. L. Wilcox, F. Richard, R. E. Galloup, J. E. Edwards, Walter Burke, and F. T. Smith.

Chester Donnally Is Appointed to Grant and MacClatchie Offices

Chester Donnally, former supervisor of Texas operations for Western Geophysical Company of America, has been appointed vice president of Grant Oil Tool Company and MacClatchie Manufacturing Company in charge of Mid-Continent sales and service, with headquarters at Dallas.

Donnally was graduated from Southern Methodist University with a B.S. in geology, and in 1930 was employed by Geophysical Service, Inc., in the Dallas area. Four years later he transferred to Western Geophysical Company and after some time as party chief in the San Joaquin Valley territory of California was returned to Dallas as supervisor of Texas operations, which position he has held until this most recent appointment.

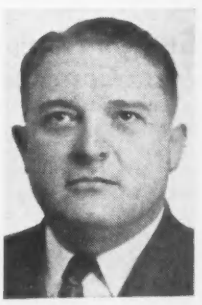
Weco Promotes John W. Gates

John W. Gates has been promoted to assistant sales manager of Well Equipment Manufacturing Corporation. He joined Weco as shop foreman in 1946 after four years with the Navy. For the past two years he has been a division manager and prior to that was Gulf Coast representative.

Gotkool
WATER CANS
& COOLERS
Gott
GOTKOOL
WATER COOLER
PURE WATER
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today! . . . .
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

Division Credit Manager in Canada Is Appointed by National Supply

Ivor K. Thomas has been appointed division credit manager of The National Supply Company, Limited, Oil Field division. His activities will cover the provinces of Alberta, Saskatchewan, and British Columbia and he will make his headquarters at Calgary, Alberta.



Ivor K. Thomas

Thomas joined National Supply in 1944 as a credit clerk in the company's Pittsburgh office. In 1946 he was transferred to Olney, Ill., as field credit representative and came to Canada in 1949 as district credit manager at Calgary.

"Oilwell" Appoints Superintendent Of New Garland, Texas, Facilities

Dewey R. Moore has been appointed superintendent of Oil Well Supply Company's new warehouse and modification center at Garland, Texas. He has been assistant manager of drilling equipment sales in the "Oilwell" general sales department since December, 1945.

Dewey R. Moore

The Garland installation will supply the company's more than 50 stores in the Southwest, and will also serve as an assembly plant for certain parts.

Ivan A. Jones has been named manager of the company's field store at El Dorado, Kansas. District representative at Wichita for the past several months, he joined "Oilwell" in 1948.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Craig Is Named District Manager For Continental Supply Company

William D. Craig, formerly assistant district manager for The Continental Supply Company in charge of East Texas operations, has been made district manager for the Rocky Mountain district, with headquarters in Casper, Wyo.

William D. Craig

James R. Chapman replaces Craig and will maintain headquarters in Tyler, Texas. He comes from the Casper store.

R. C. Wiggins and R. W. Woodside have been promoted to managers of Continental Supply Company stores at Russell, Kansas, and New Harmony, Ind., respectively.

Harvester Mobile Training Units Now on Nation-Wide Service Tour

The latest service and maintenance information on International Harvester industrial power products is being brought to the company's district office and distributor service personnel by two mobile training units now on a nation-wide tour.

Each unit consists of an International L-180-series truck with a 32-foot, drop-frame, enclosed semi-trailer, especially equipped for both a service and sales-training program.

Two instructors present the International product servicing story with the aid of charts, slide films, and movie films. Sets of special tools and equipment will be displayed on the walls of each trailer and usage will be detailed during the discussion period.

While the fuel injection system classes will be presented in the trailer laboratory, all cutaway models are caster-mounted so they can be readily removed from the trailer and wheeled to the location where the training program will be conducted.

Interior view of International Harvester's 32-foot trailer, showing the caster-mounted models, the display of special service tools and equipment, and complete fuel injection system laboratory.

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This Work-Saver RIDGID assures you..."No pipe wrench housing repair expense."

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You can maintain your required speed for the full period of the test with much less effort. Curtin centrifuges, proven world-wide, are heavy duty, rigidly constructed, and extremely simple in design. Illustrated bulletin, giving full details, available upon request.
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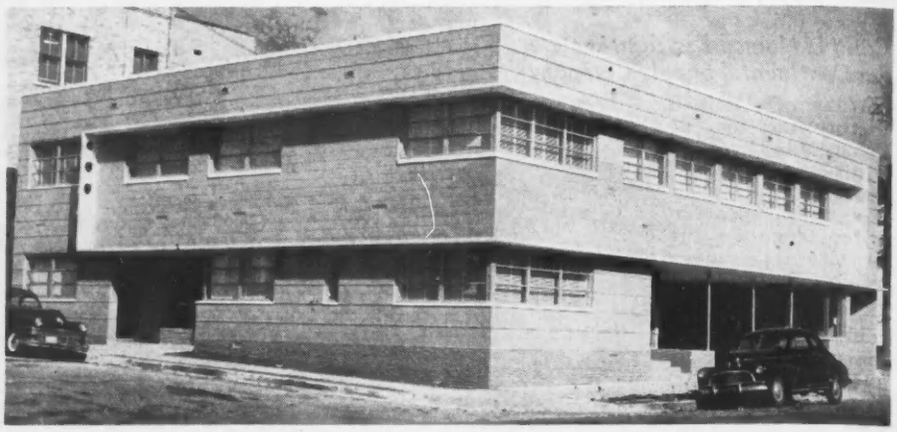
HOUSTON . . . . NEW ORLEANS.

EQUIPMENT and SERVICE SUPPLIERS' NOTES



Independent Exploration Company's new North Texas division offices at 740 West Fifth Street, Fort Worth, are pictured above. The entire upper floor at this location takes the place of two suites of offices that Independent formerly occupied in the Electric Building and the Bewley Building in Fort Worth. John H. Wilson, vice president, is in charge of the offices. Other staff members include David B. Campbell, assistant manager; George Harrington and George B. Clark, in charge of the correlation of geophysical and geological work; Miss Cal Yates and Mrs. Josa Runnfer, draftsmen; and Mrs. Archie Smith and Mary Cherry.

Veteran Sales Executive Appointed Manager of Strata-Crete Division

Robert M. Cook has been appointed manager of the newly organized Strata-Crete Sales division of Great Lakes Carbon Corporation.

Robert M. Cook

Cook will initially handle two newly developed products for use in the oil field—Strata-Crete and Strata-Seal. Strata-Crete is a lightweight material for use in oil well cementing. Strata-Seal is a lightweight additive for drilling muds to combat lost circulation.

For the past seven years, Cook was vice president and general sales manager of Security Engineering Company, Inc. Previous to that he was general sales manager of McCullough Tool Company and before that was vice president and general manager of International Cementers, Inc. For the six years preceding this, he was president of Pacific Cementing Company.

Cook will maintain his offices at 5845 Atlantic Avenue, Long Beach 5, California. Sales offices are already established in principal oil centers.

Core Lab Increases Equipment and Expands Field Service Facilities

Core Laboratories, Inc., has installed new vacuum-type retorts to facilitate analysis of large cores from vuggy or fractured formations, in the firm's permanent laboratory at Midland. Identical equipment is also being installed in Field Lab No. 25 (semi-portable unit), soon to be stationed in the Snyder territory.

Other equipment and facilities improvements include the modification of Field Lab No. 23 from a core analysis unit to a "logger," fully equipped for on-location well-logging service, in combination with on-location core analysis; the completion of Field Lab No. 39, a new light-weight field lab with improved maneuverability; and the near-completion of Field Lab No. 40 and Suitcase Lab No. 2, both constructed for use on off-shore locations.

Core Lab has opened a permanent laboratory in Eldorado, Ark., managed by Ray Bell under the direction of Ralph W. Parnell, Shreveport, district engineer of the East Texas, North Louisiana, Mississippi, and Arkansas areas; and a permanent lab in San Antonio, to be managed by C. D. Christian, under the direction of R. J. Granberry, district engineer for the South Texas and Lower Gulf Coast areas.

Cleco Division Plant in Houston Produces Dallett Pneumatic Tools

The Dallett Company of Philadelphia, which was purchased in 1947 by the Reed Roller Bit Company, has been moved to the Cleco Division plant in Houston, Texas, where production of Dallett tools and accessories is now in progress.

The combined facilities of the Reed Roller Bit Company in Houston cover 42½ acres of land with more than 1000 machine tools and 542,255 square feet of floor space.

Fluid Packed Pump Company Holds Conference of Division Managers

The division managers of Fluid Packed Pump Company recently met at the Tulsa Hotel to discuss plans for expanding sales and service facilities for Oilmaster pumps. The meeting was attended by J. B. Reilly, president and general manager; M. S. Black, plant manager; Sidney Shuman, general sales manager; Glen W. Peters, assistant sales manager; G. R. Newbolt, manager of Oklahoma, Kansas; C. D. Newbolt, manager of Gulf Coast, East Texas, Louisiana, Mississippi and Arkansas; B. G. Wing, manager of the Eastern division; and Dee A. McDaniels, manager of North Texas, West Texas, New Mexico and the Panhandle.

Sidney Shuman

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Airco Manufacturing Constructs Plant Facilities at Union, N. J.

Immediate construction of a new manufacturing plant of approximately 272,000 square feet, on a 25-acre plot at Union, N. J., has been announced by John A. Hill, president of Air Reduction Company, Inc.

This new facility will be used by the Airco Equipment Manufacturing division of Air Reduction Company, Inc. for the manufacture of welding and cutting torches, tips, regulators, oxyacetylene cutting machines, inert gas arcwelding machines, acetylene generators, oxygen and acetylene manufacturing and distribution equipment.

First Ideal Type 130 Rig Installed On Texas Company Drilling Barge

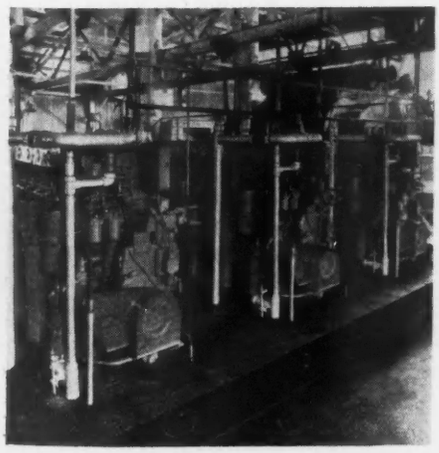
The first of The National Supply Company's new Ideal Type 130 Drilling Rigs has been installed and is now operating on the drilling barge Gibbens, owned by The Texas Company and built by Levingston Shipbuilding Company of Orange, Texas.

Drilling barge Gibbens was designed to drill wells to 15,000 feet and was built under the supervision of the Producing department of The Texas Company's Louisiana division. It is 160 feet long, 54 feet wide, and has a depth of 12 feet. The slot measures 82 feet long by 10 feet wide.

The engine drive back of the drawworks, or rig drive group, is essentially a standard design of National's. This drive group was tailored to suit the needs peculiar to barge mounting.

Power is furnished by three PTD-8 naturally aspirated Superior diesel engines which have an 8½-inch bore and a 10½-inch stroke and are rated for intermittent service at 460 hp without radiators, 900 rpm.

The drawworks itself has six speeds for hoisting service and provides three speeds for driving the catshaft and the rotary machine. Its drum is 30 inches in diameter, 56¼ inches long, and is grooved for 1⅜-inch wire rope. This rope has a breaking strength of approximately 78 tons. The drum size is engineered to gain line service—only three layers of line need be spooled on the drum at one time.



Three Superior PTD-8, 8½ by 10½ diesel engines furnish power for the new Ideal Type 130 drilling rig, mounted on The Texas Company's drilling barge Gibbens.

and now . . .

WHAT'S AHEAD for the oil industry?

What's the outlook for production in 1951? How many wells will be drilled? Where? How about total footage? Will oil demand increase or decrease? What about imports? Exports? How many wells will go on pump? How much pipe line construction ahead?

you'll find the answers in the

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of

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In this special issue of WORLD OIL, to be published February 15, 1951, you'll find the answers to many of the questions now cropping up about the coming year. Every phase of the oil producing business will be *reviewed* and *analyzed*. And after careful study, dependable *forecasts* will be made on what to expect in 1951.

This issue, graphically illustrated with tables and charts, brings you important information on oil supply, demand, imports, exports, prices, production, reserves and legislation affecting the oil business.

You can review wildcatting success in 1950 . . . check field activity over the country. There's a review of wells and footage drilled in 1950 . . . and a forecast for 1951. New drilling and production methods and equipment are reported. There are forecasts on oil and gas production and consumption.

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A Regional Study Conference in well logging, the first of a series, was conducted by Schlumberger Well Surveying Corporation in Houston. Pictured are the technical men selected from among Schlumberger's customers and company engineers who attended the five-day meeting. The conference covered topics in the general fields of well logging theory, interpretation and applications. Individual problems of the visiting group were discussed with members of the Schlumberger technical staff.

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Prevent costly shutdowns, keep bottom water out of your wells, with effective, economical Eagle-Picher Lead Wool. The fine, flexible strands fill cracks and crevices with a permanent, non-corrosive seal... save you time and money. Packed in convenient 50-pound sacks — easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.

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These **3** *Eagle-Picher Bearing Metals meet most requirements*

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2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

Rockwell Manufacturing Appoints Weimar As Advertising Manager

W. F. Weimer

A. C. Daugherty

W. F. Weimer has been named advertising manager of Rockwell Manufacturing Company of Pittsburgh, succeeding William A. Marsteller, resigned. Weimer has been with the Rockwell organization for more than a decade in the Gas Products Sales department, as editor of employe publications, and, for the past several years, as advertising manager of the Pittsburgh Equitable Meter Division.

A. C. Daugherty has been named manager of market research. He joined the company as a student engineer upon graduation from Penn State, and in 1947 became a market analyst in the Market Research department.

Baroid Sales Division Will Move National Headquarters to Houston

The general offices of the Baroid Sales Division of National Lead Company, including the sales, administrative and research departments, will be moved in 1951 from the Los Angeles headquarters to Houston.

Contracts have been let to construct a 40,000 square-foot steel and concrete two-story headquarters building in Houston, with completion scheduled for July 1 occupancy. Houston has been headquarters for Baroid's Gulf Coast division, with offices in the City National Bank Building.

Key Halliburton Employes Attend Supervisor's School at Duncan

Coming in from 20 states and Canada, 120 key field representatives of Halliburton Oil Well Cementing Company attended a supervisor training course at Duncan, Okla., Halliburton's home office. Conducting the course was D. A. Weaver, Institute of Public Safety of The Pennsylvania State College, State College, Penn.

First of its kind conducted by Halliburton, the course emphasized field and shops safety through selection of reliable personnel and effective training methods; better employe and customer relations; modern supervisory practices; and improved efficiency resulting from streamlined operations.

W. I. Kent, Magnolia Petroleum Company's safety director, Dallas, participated in the course also.

Pointing to the Halliburton company's worldwide operations, company officials explained the course is designed to bring key operating personnel together to discuss common problems.

Diesel Specialist Joins National In Charge of New Washington Office

Ralph S. Lorimer has been appointed branch manager of The National Supply Company's new Washington, D. C., office.

Lorimer's background in diesel engineering dates back to 1917, the year he joined the Atlas Imperial Diesel Engine Company of which his father was one of the founders. He has been engaged in almost every phase of diesel engine manufacturing, including development work, field engineering, production, sales, and was, immediately prior to joining National Supply, in charge of the Lorimer Diesel Engine Company of the Atlas Imperial organization.

Worthington Pump Company Names Sales Personnel, Training Head

J. J. Thompson has been named manager of the Sales Personnel and Training division of Worthington Pump and Machinery Corporation at Harrison, N. J. Thompson was formerly assistant manager of Worthington's Cincinnati office, will assume his new position at Harrison January 2.

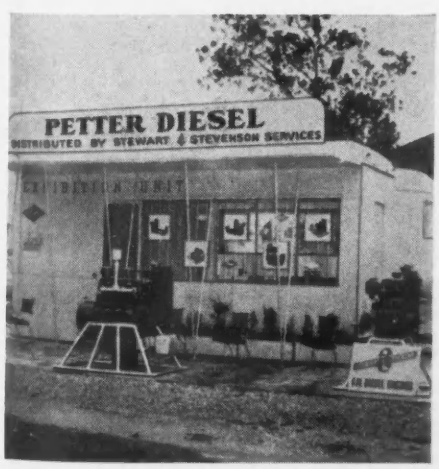
A 17-year Worthington veteran, Thompson has been with that company since 1930 except for three years with the War Production Board from 1941 to 1944. He became an estimator in the Chicago office after graduating from Purdue University with a B.S. degree in mechanical engineering 20 years ago.

Big Four Adds Oklahoma Warehouse

Big Four Machine & Supply Company has established a warehouse in Oklahoma City, with Clearman Tool Company who will represent the oil field equipment firm. Big Four products are available at the warehouse, 729 South East 29th Street, to all supply companies and drilling contractors.

Manhattan Rubber Promotes Two

Two sales promotions have been announced by Raybestos-Manhattan, Inc. Manhattan Rubber Division, Passaic, N. J. John T. M. Frey has been appointed assistant manager of the New York branch and Lamar S. Hilton is now assistant sales manager of the Abrasive Wheel department.



Stewart & Stevenson Services was host in Houston to the pictured traveling industrial exhibit of one of Great Britain's leading manufacturers, British Oilfield Engines, Inc., manufacturers of Petter diesel engines. The Petter diesel engine, distributed in Texas by Stewart & Stevenson Services, was the featured product in the special industrial exhibit prepared in England and shipped complete to the U. S.

PARAFFINITIS*
ISN'T INCURABLE
Here's good news for operators who are repeatedly spending money to remove paraffin from pumping wells. You can positively prevent the accumulation of paraffin by the installation of Huber Scrapers.
With these blades permanently attached to sucker rods in the area where accumulation takes place, paraffin is wiped from the tubing walls by the reciprocating and rotating action of the rod string. It is then pumped out of the well.
GET DOUBLE BENEFIT
Only with the Huber method do you get the double benefit of the combined rotating and reciprocating motion which wipes paraffin from the tubing in particles so small they go out in solution . . . so small they can not clog tubing, scrapers, or flow lines. Rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equally distributing wear on working barrel. Get this added benefit while eliminating paraffin accumulation by installing Huber Scrapers and Huber Rotating Rod Hangers.
Install Huber Paraffin Scrapers and Rotating Rod Hanger, NOW! End costly, frequent steaming out or rod pulling to remove paraffin.
* Congestion caused by the accumulation of paraffin in pumping wells.
For further information see your local supply store, or write
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HUBER
PARAFFIN SCRAPERS
SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

Union Wire Opens 13th Branch and Shifts Eastern Sales Personnel

The 13th in its network of branch offices and warehouses has been opened at 1341 Vega Street in Jacksonville, by Union Wire Rope Corporation. George Golay, who has represented the firm in Southeastern territory, is now district manager. Melvin Hass, graduate of Kansas University and Union's laboratory and mill training school, has joined the Jacksonville sales staff and is assigned to the Carolinas, Georgia and Alabama territories.

Other transfer of Union Wire Rope sales personnel take D. E. Bedford to Eastern Pennsylvania and New York territory from Iowa and Nebraska, where he has served several years. Eugene R. Rhue, graduate of Kansas University and Union's laboratory and mill training school, will succeed Bedford in the Iowa-Nebraska territory.

Conference Board Elects Belnap

L. J. Belnap of Montreal, who is a board member and chairman of the executive committee of Worthington Pump & Machinery Corporation and chairman of the board of Consolidated Paper Corporation, Ltd., was recently elected as a board member of the National Industrial Conference Board, Inc. for a one-year term.

Plomb Tool Company Names Rich to Direct Proto and Subsidiary Sales

Lawrence M. Rich has been appointed vice president and general sales manager of the Plomb Tool Company, Los Angeles, and will direct all sales and related activities for Proto tools. He also supervises the sales operations of the company's subsidiaries.

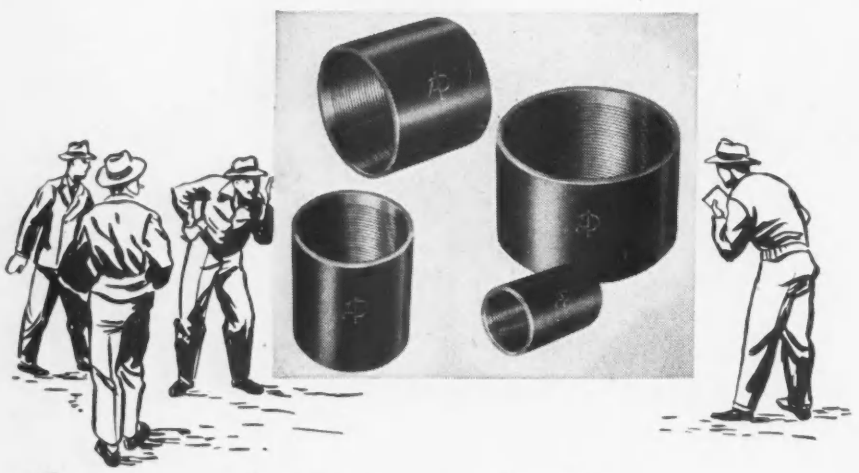
L. M. Rich

Rich originally joined the company in 1929 and was Eastern sales representative until 1932. He then served the Marlin-Rockwell Corporation for eight years as New York branch manager. He was in the U. S. Army for six years during World War II and rose to the rank of Major in the Ordnance Department. From 1946 to 1950 he was director of sales of the Durkee-Atwood Company, Minneapolis.

Franks Manufacturing Firm Names Southwest Texas District Manager

Hilmer Heinritz, with Franks Manufacturing Corporation of Tulsa since 1940, has been appointed district manager of Franks sales and service branch for Southwest Texas, according to Carl White, Jr., president of Franks. Heinritz, who will have headquarters at Alice, Texas, has had wide experience in Franks assembly shop and service department.

Hilmer Heinritz



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Harrisburg SEAMLESS STEEL PIPE COUPLINGS

AMAZING THREAD ACCURACY is one reason why Harrisburg Seamless Steel Pipe Couplings are preferred throughout the petroleum industry.

They are threaded on special machines, assuring accuracy of form, height, angle, and lead—meeting the most critical requirements demanded by engineers today.

Threads are electro-galvanized . . . will not gall under the most severe strain. Harrisburg Seamless Steel Pipe Couplings are manufactured to *A.P.I. specifications!*

WRITE FOR CATALOG on Harrisburg Seamless Steel Pipe Couplings. There's another on Harrisburg Drop-Forged Steel Pipe Flanges, too. Both are free for the asking.

HARRISBURG STEEL CORPORATION
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Custom-Built Quality Products in Quantity
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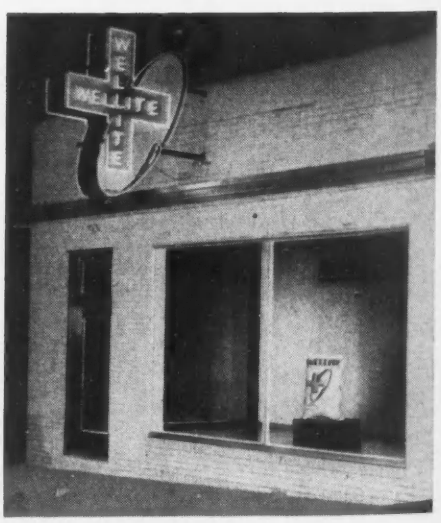

Wellite Corporation's headquarters building at 2518 East 15th Street, Tulsa, is pictured. Distribution of Wellite light-weight additives for drilling fluids is handled by Cardinal Chemical, Inc., Odessa, Texas, and stock points in Texas, Louisiana, Mississippi, New Mexico and Oklahoma.

Continental Europe Representative Is Appointed by Edward Valves

Edward Valves, Inc., East Chicago, Ind., has appointed Societe Audco Belge S.A., Brussels, Belgium, as Edward sales representative in continental Europe. All sales contacts will be under the supervision of Fred O. Spitzer of the Audco Belge sales staff, who will travel Belgium, Denmark, France, Holland, Italy, Luxembourg and Switzerland.

Societe Audco Belge is a subsidiary of Audley Engineering Company, Ltd., Newport, Shropshire, England, which is licensed to build and market Nordstrom lubricated plug valves in the British Isles and on the Continent.

Nordstrom, which headquarters in Pittsburgh, is a division, and Edward Valves is a subsidiary of Rockwell Manufacturing Company, Pittsburgh.

Seismograph Specialist Organizes Geophysical Consultants in Tulsa

Charles C. Brooks has resigned from Seismograph Service Corporation and has organized Geophysical Consultants, Inc., of which he is president, with offices at 520-21 McBirney Building, Tulsa. Brooks has been in the seismograph end of the industry for 20 years and for the past 13 was with SSC in a supervisory capacity in both foreign and domestic exploration. Previous to his employment with SSC he was with Amerada Petroleum Corporation in its Geophysical department.

C. C. Brooks

Thermoid Selects District Manager For Mid-Continent and California

Marvin L. (Jack) Cunningham has joined the sales organization of Thermoid Company as district manager in charge of oil field friction materials in the Mid-Continent and California. His headquarters are in Tulsa. Cunningham has previously worked for Humble Oil & Refining Company, Halliburton Oil Well Cementing Company and Gulf Oil Corporation, and before joining Thermoid was sales manager for Standco Brake Lining Company.

M. L. Cunningham

Thermoid has offices and factories in Trenton, N. J., and Nephi, Utah.

Borg-Warner Establishes Two Units For Ingersoll Steel Manufacturing

Separation of the Ingersoll Steel division of Borg-Warner Corporation into two distinct and independently operated manufacturing units was announced following a meeting of the division's board of supervisors.

One unit, which will continue to be known as the Ingersoll Steel division, with steel mills at New Castle, Ind., will be headed by Harold G. Ingersoll as president and general manager.

The other division, with plants in Chicago and Kalamazoo, Mich., will be directed by Robert S. Ingersoli as president and general manager and will bear the name of the Ingersoll Products division.

Seamless Products Manager Named

W. R. Ryburn, for the past 3 years manager of National Supply Company's drilling equipment sales in Toledo, has been appointed manager of seamless products sales for the Spang-Chalfant division with headquarters in Pittsburgh. He succeeds R. M. Burk, who left the company to enter the oil business.

Rockford Clutch Executive Named

Harry L. Emerson has been appointed vice president in charge of manufacturing of the Rockford Clutch Division of the Borg-Warner Corporation. He also will continue as works manager, a position he has occupied for eight years.

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Down time is costly Drilling and other hard working oil country equipment require bearings that can resist extremely severe stress, loads and shock in round-the-clock service without wear or failure. The conception and building of special bearings for such rugged service is a basic part of our business—has been for over a third of a century. Made from high carbon or alloy steel specially heat-treated and meticulously ground, Aetna custom bearings possess plus quality that unfailingly shows up in lowest final costs.

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A new plant addition, new processes and machinery, new and completely modernized engineering laboratory facilities—from these new Aetna resources will come the best bearings we have ever built, advanced anti-frictioneering service to better the oil country equipment you buy or build tomorrow.

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings

Gardner-Denver Company Establishes New Ontario Manufacturing Concern

Gardner-Denver Company has established a Canadian plant at Brantford, Ontario, to be operated by Gardner-Denver Company (Canada) Limited. Key production men will be temporarily transferred from the parent plant, Quincy, Ill., but both skilled and unskilled labor will be obtained in Canada. Production of the new plant will be handled through the seven branches offices in Canada maintained by Gardner-Denver.

Plant Safety Records Are Cited

Two plants of the American Steel & Wire Company, at Cleveland and Trenton, N. J., have been honored by the National Safety Council for outstanding safety performances during the past two years, it was announced today by W. F. Munford, vice president—operations.

Byron Jackson Company Appoints Branch Manager at Los Angeles

C. O. Relephord has been appointed Los Angeles branch manager for the Pump division, Byron Jackson Company, with territory covering several western states, Mexico and the Far East.

C. O. Relephord

Relephord was graduated from the University of Oklahoma in 1932 with a B.S. degree in petroleum engineering, refinery option. He then was employed in a sales engineering capacity. After serving during World War II with the U. S. Pacific Fleet, in 1946 Relephord joined Byron Jackson in the Houston office.

Centrifugal Compressor Specialist Is Engaged by Cooper-Bessemer

John Fulleman, specialist in engine supercharging and centrifugal compressor design, is working with Cooper-Bessemer Corporation's engineering staff coordinating an engine development program at the Mt. Vernon, Ohio, headquarters plant.

John Fulleman

Fulleman was born in Switzerland and received his technical engineering training at the Federal Institute of Technology in Zurich.

Wickwire Spencer Appoints Frizzell Structural Products Sales Manager

Richard H. Frizzell was named sales manager of the Structural Products department of the Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation. He succeeds G. L. Crawford who becomes sales manager of the Division's Buffalo Sales district.

Richard H. Frizzell

Frizzell went to work for the Wickwire Spencer Steel Company in 1933, and has served in various capacities in the Sales department and the mills.

H. K. Porter Plant in Tulsa Will Manufacture Jarecki Line of Valves

H. K. Porter Company, Inc., Pittsburgh, has formed the Jarecki Valve Division, Tulsa, to handle the manufacture and sale of Jarecki valves formerly produced at the Jarecki Manufacturing Company plant in Erie, Penn. The Jarecki company's complete line of iron and bronze valves and cocks will be made in H. K. Porter's Hinderliter Tool Company division plant.

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One completely rebuilt LP-600 Cummins Diesel Power Unit; new block, pistons, liners, camshaft, bearings, crankshaft .010 under, radiator, B-218 Twin Disc Clutch and Air Starting equipment; warranted, very reasonable price.

One Model LI-600 Cummins Diesel Engine, completely rebuilt, for sale either as Power Unit or as 100 KW Generator Set, V-belted to 1200 RPM General Electric Generator with Switchboard.

One Model LI-600 Cummins Diesel Engine, completely rebuilt, 720 RPM, on common steel base, direct-connected to General Electric generator, serial #5432799, Type AT1, frame #7632, 480-volt, 3-phase, 60-cycle, 125 KVA, 80% power factor, 100 KW, with 125 volt exciter, 22.5 amp.

For further information, write Valley Land & Warehouse Company, Inc., 502 Weatherly Building, Portland 14, Oregon.

■ FOR SALE: 9500 ft. electric conducting cable, new, never used, prestressed and preformed, 48,000 lbs. breaking strength. 2507 Mercantile Bank Building, Dallas, Texas.

■ **Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.**

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HELP WANTED

Position Available February 1, 1951. Assistant or Associate Professor with Masters degree or higher in Petroleum Engineering to teach reservoir engineering courses in rapidly growing school with excellent laboratory and other facilities. Qualifications will determine salary, but will be comparable to industry. Location Southwest. Box 6-W c/o World Oil, Houston, Texas.

■ DRILLERS wanted in Australia. Experienced cable tool drillers required operate modern rigs on Australian sheep stations. Good salary and bonus rates. Apply Overall McCray Pty. Ltd., Pyrmont, Sydney.

■ Wanted Sales Engineer between 25 and 35 years. M.E. or Petroleum Engineering experience. Sell new equipment oil and gas fields. Car necessary, travel Texas. Mail complete experience. Box 7-W, c/o World Oil, Houston, Texas.

■ Wanted Oil Finder. Want to contact party who has machine for locating oil. Must operate mechanically. Write 774 Mulberry, Abilene, Texas.

SITUATION WANTED

■ Pipeline Superintendent — Years experience field and office operations. Crude Oil Purchaser with Major and Independent Pipelines. W. J. Flahie, Drawer 18, Rodessa, La.

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to **Box 94-W**, WORLD OIL, Houston 1, Texas.

Gasoline Plant, Production, Drilling and Construction Superintendent, age 34, married. Desires position with progressive independent oil company. Box 4-W, World Oil, Houston, Texas.

New Books, Maps and Movies

Petroleum Geography

A comprehensive study of the occurrence of oil throughout the world, "World Geography of Petroleum" takes into account the surface location and subsurface conditions of petroleum accumulation. The work, edited by Wallace E. Pratt and Dorothy Good, includes papers by an impressive list of oil specialists, geologists and geographers. It covers, in one section, the origin of oil in various sectors of the world, the organization of the petroleum industry, production practices, elements of refining and transportation, and the world movements of petroleum. This section is followed by detaied outlines of all the oil producing countries and areas in the world, delving into the aspects of regional geology, topography, climate, vegetation, accessibility, population, and cultural and industrial development. In addition, the future prospective oil areas are analyzed and the economic effect of oil upon the individual countries and the world as a whole are discussed.

The 408 pages of text contain 50 specially prepared maps, 11 diagrams and 98 photographs pertinent to the subject.

Princeton University Press, Princeton, New Jersey, $7.50.

Yearbook

The 41st edition of "Oil and Petroleum Year Book" presents information on 790 oil companies operating in all parts of the world and covering all branches of the oil industry. Data given include names of directors and other officials, description of business, where operating, crude oil production, refinery runs, details of capital, dividends and financial results. Names and addresses of 470 managers and engineers and their company affiliations are also listed. A "Buyers' Guide of Manufacturers" of oil field and refinery equipment comprises 718 headings.

Walter E. Skinner, 20 Copthall Avenue, London E.C. 2, England. $4, postpaid.

Iran Labor Conditions

A short booklet covers the problems of procurement, training, conditions of work, housing and social services of labor in the oil fields of Iran. Initially, the greatest problem facing the industry in early years was the training of native labor in semi-skilled and skilled categories. Most of the native help employed came from nomadic tribes in the desert region surrounding the oil fields. As they could neither read nor write it was necessary to teach them the fundamentals of their own language before they could be taught the most basic phases of the work in the fields. Following this stage, the workers were moved on to semi-skilled and skilled positions. To accomplish all this training at the outset foreign technicians were employed and these people are now gradually being replaced by native labor as the processes of training advance. The booklet deals largely with the present economic status of the native workers as compared with a few years before—going into wages and prices, hours of work and social security.

International Labor Office, Washington Branch, 1825 Jefferson Place, N. W., Washington 6, D. C. 60 cents.

Technological Review

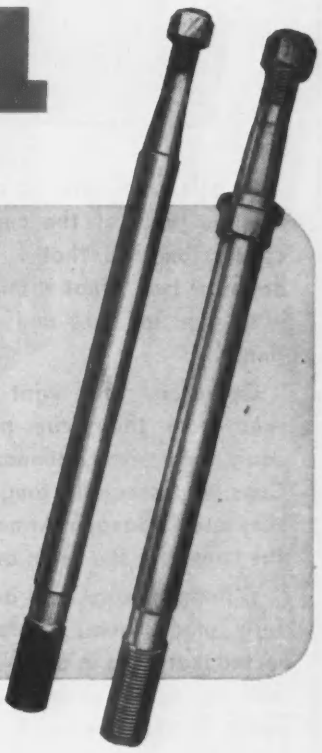
Selected literature published during 1947 has been compiled by F. H. Garner and E. B. Evans, honorary editors, and George Sell, editor, in Volume 9 of "Reviews of Petroleum Technology." Abstracts of papers which appeared in U. S., English and other oil papers are presented, as well as original reviews of technological advances in petroleum made during 1947.

This volume follows the general line of its predecessors in the series. Its 25 chapters cover the full range of petroleum industry from geology to legislation. There are references to more than 2000 technical articles and patent specifications.

Institute of Petroleum, 26 Portland Place, London, W. 1, England.

RED DEVIL

"DIA-HARD" PISTON RODS



For high pressure abrasive service

RED DEVIL Piston Rods are first choice where drilling conditions are severest because of the extreme hardness of the deep HIGH-CARBON wear resistant "DIA-HARD" case, coupled with tough core properties which give the highest tensile strength against breakage. All rods are hardness tested and precision gauged to maintain a world-wide reputation for quality. Write for Catalog No. P-101.

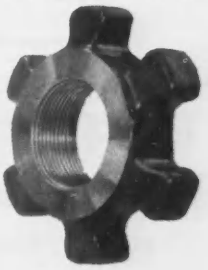
RED DEVIL PISTON PULLER

For tapered type rods

The usual practice of removing pistons from rods by blows of a sledge hammer often damages either pistons or rods. A Red Devil piston puller easily and quickly removes badly stuck pistons without injury to either part. All elements are made of finest quality alloy steel, heat-treated for strength and long life. Write for Catalog No. P-106.

RED DEVIL PISTON ROD LOCK NUT

These "Hammer Lug Type" nuts provide a fast and positive means for locking piston rod in crosshead. Made from alloy steel and heat treated, they will last indefinitely. Face of nut is precision machined for full seating surface at right angles to axis of threads to prevent fatigue stresses in rod. Write for Catalog P-102.



Complete information in Composite Catalog or write for price catalogs noted above. Red Devil products are available through your supply store.

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DRESS UP YOUR CUP PLUNGERS WITH O'BANNON VALVE CUPS

In selecting valve cups it is not the price of the cups that counts, because that is only a dollar or two. What is important is to save rod jobs and production.

Operators who want longer runs from their cup plungers equip them with O'Bannon Valve Cups. In especially tough wells they use O'Bannon Armorflex—the cups with the nylon armor.

O'Bannon valve cups are skillfully made from carefully selected materials in an up-to-date well-equipped plant, conveniently located for quick delivery—the only cup plant west of the Mississippi. The cups are formed, punched and trimmed to exact size, and they are uniform because molds are especially treated to resist wear. Armorflex cups have outer layers made of nylon, the strong, tough material which is so resistant to abrasion.

Next time you repair a cup plunger, dress it with cups from the familiar red box, and you'll be pleased with the results.

AVAILABLE AT YOUR SUPPLY STORE

Walter O'Bannon Co.

Tulsa 1, Oklahoma

All the Right People

A young lady was on a sight-seeing tour of Detroit. Going out Jefferson Avenue, the driver of the bus called out places of interest.

"On the right," he announced, "we have the Dodge home."

"John Dodge?" the lady inquired.

"No, Horace Dodge."

Farther out Jefferson.

"On the right we have the Ford home."

"Henry Ford?" queried the lady.

"No, Edsel Ford."

Still further out Jefferson.

"On the left, we have Christ Church."

A fellow passenger, hearing no question from the young lady, tapped her on the shoulder and said, "Go ahead, lady, you can't be wrong all the time."

Black Magic

The first grade teacher was pleased to note that little Willy was paying close attention during the arithmetic lesson. After she had done several problems on the blackboard she asked if there were any questions. Willy had one.

"Where do the numbers go when you rub them out?"

Penny Wise

A dollar and a penny met. The penny had a bright, clean face; the dollar was dirty but proud.

"You think you are gold, but you are only cheap metal," said the dollar. The penny replied, "I am what I am and claim to be no more."

The dollar swelled up with pride and said: "I am patriotic, I am trustworthy, I have the emblem of liberty on my bosom, and the United States Government has placed these words on me, 'In God We Trust.'"

After a little doubt, the penny answered: "I grant you all of that, but I go to church oftener than you do."

Merlin Was a Lady

Maybe you can't make a silk purse out of a sow's ear, but many a woman has gotten a mink coat out of an old goat.

"Why, Mr. Foster! I couldn't think of accepting gifts from you unless it was an eighth override on your production, or offset leases on your new pool . . .!"

Top Billing

At one of the newly reactivated training camps a corporal was driving a truck into the gate when he was stopped by a guard.

"What you got there?" the soldier asked.

"Load o' garbage and a recruit," replied the driver. They drove on a couple of blocks and were stopped again.

"What you got there?" asked the second guard.

"Load of garbage and a recruit," repeated the driver.

Again and again they were stopped and went through the same routine. Soon the recruit began to show signs of dissatisfaction.

As the truck approached the next gate he spoke up: "Say, corporal," he said plaintively, "can't you get me some kind of a priority and put my name first?"

Roman Buffet

A Sunday School teacher was showing her class a picture of the Christian martyrs in a den of lions. One little boy seemed very much worried about something.

"Gee," he said sadly, "look at that poor lion in the back. He won't get any."

McCULLOUGH SERVICES:

A ELECTRIC WIRE LINE SERVICES

1. PERFORATING—Deepest penetrating burrless bullet and jet.
2. BRIDGING PLUGS—Drillable, expandable. McCullough and Baker.
3. MAGNA-TECTOR*—Locates stuck point of pipe, accurately, fast!
4. JET CASING CUTTERS*—World's fastest casing, tubing, drill pipe cutter!
5. JET BACK-OFF TOOL* and STRING SHOT—World's fastest way to recover stuck pipe!
6. JET BOTTOM HOLE CUTTERS*—Fragmentizes lost or stuck fish!
7. ELECTRONIC WEIGHT INDICATOR*—Supersensitive, small, light!
8. SONIC COLLAR LOCATOR*—Locates collars, liner tops, well bottom, etc.
9. MAGNETIC FISHING TOOL*—Surface indicates location and recovery of fish.

B ROTARY SERVICES

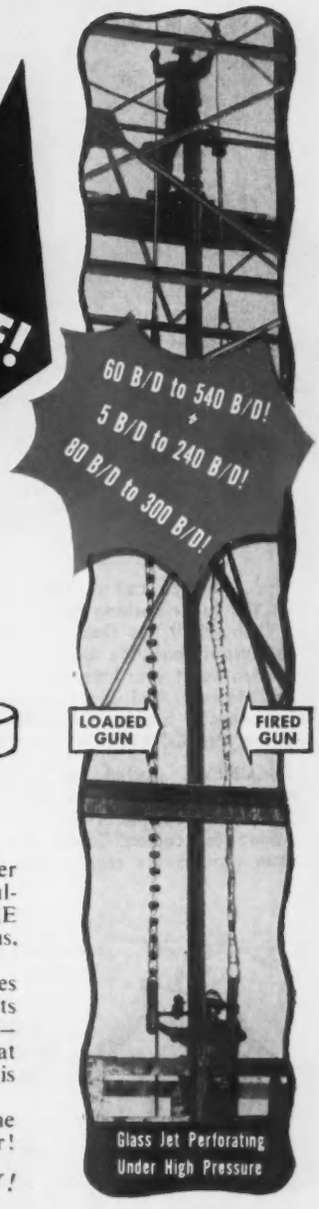
1. DOUBLE ACTING ROTARY JARS* and BUMPER SUBS—Reduces number of fishing jobs!
2. SAFETY JOINTS—Releases quickly in emergencies!
3. EXTERNAL DRILL PIPE CUTTERS—For all outside pipe cutting.
4. MECHANICAL LONG KNIFE INTERNAL CASING CUTTERS—All sizes pipe, tubing.
5. THIN WALL EXTERNAL CASING CUTTERS*—For outside cutting in small clearances!
6. ROTARY RELEASING OVERSHOTS—Completely encircles fish.
7. ROTARY RELEASING SPEARS—Engages or disengages at will.
8. GUN TESTER—Water shut-off, perforating, testing in one run.
9. JUNK BASKET—Crushable finger type. 5 minutes on bottom.

*Exclusive McCullough Services

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

McCULLOUGH® GLASS JET PERFORATORS

Mean MORE OIL in the tank, even after all other methods fail!



MORE *Oil in the TANK means MONEY in the BANK...*

...and that's what you're after!

When you want cleaner, deeper, straighter holes, even after all other methods had failed to get results, there is only one choice—the new McCullough Glass Jet Perforator. Your reward—MORE OIL in the tank, MORE MONEY in the bank! No carrots or slugs, no splitting or sticking guns, trouble-free jet perforating for the FIRST time!

No matter how you look at it the McCullough Glass Jet Perforator makes sense. The emphasis is on the Glass Jet and not on the carrier. This permits the maximum safe charge of explosives where MORE POWER is needed—in small pipe in deep wells where several casing strings exist. The special heat treated glass units disentegrate completely. The retrievable strip carrier is pulled from the well.

Whatever your perforating problems—you're after MORE OIL in the tank. GET what you're after with the McCullough Glass Jet Perforator!

AVAILABLE NOW—See Your McCullough Service Man TODAY!

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Mid-Continent NEWS and HUMOR?

THE CREOLES call it "lagniappe." (Don't let the fancy spelling fool you—pronounce it "lan-yap.") It's that "something extra," the surprise package, the icing on the cake, the feather in your hatband, the egg in your beer. Here at Mid-Continent, we turn out a very special brand of lagniappe. We call it the MID-CONTINENT NEWS.

THE NEWS started out as an "inside" magazine for employees only, but pretty soon customers and other "outsiders" began asking for copies. Today, more outsiders than insiders are reading the NEWS.

MID-CONTINENT Supply Company

General Offices Mid-Continent Bldg. FORT WORTH, TEXAS

SQUEAKS FROM THE BULLWHEEL

Reflection

A man was driving in the country one day, and he saw an old man sitting on a fence rail watching the automobiles go by. Stopping to pass the time of day, the traveler said:

"I never could stand living out here. You don't see anything. I'm on the move all the time."

The old man on the fence looked down at the stranger and then slowly drawled: "I can't see much difference in what I'm doing and what you're doing. I set on the fence and watch the autos go by, and you set in your auto and watch the fences go by. It's just the way you look at things."

Room for Improvement

A man recently had a new house built. Inspecting it, he concluded that it didn't look very strong. He mentioned it to the builder.

"Well, after all," replied the builder, "you've got to consider that we haven't got the wallpaper on yet."

Happy Days

"I feel a hell of a lot more like I do now than I did when I came," said the blonde at the cocktail party.

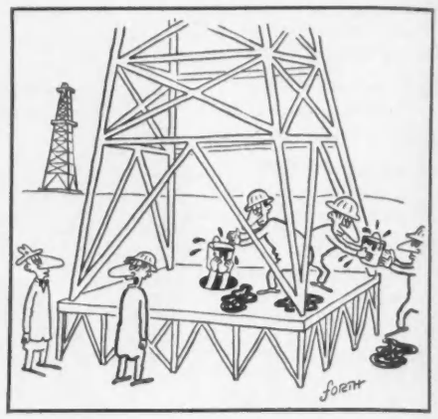
Blue-Streak Blueblood

"But officer, you can't arrest me. I come from one of the finest families in Virginia."

"That's all right, buddy. I'm arresting you for speeding, not breeding, purposes."

Spot Check

A man inspected his wife's new bathing suit and remarked caustically, "Agnes, it's just big enough to prevent your being tanned where you ought to be."



"Our pump is out of order."

Heaven's Halfbacks

We can't vouch for this yarn, but the story goes that a reporter boarded the train carrying the Notre Dame team to a crucial football game last season. Thinking to get a new slant on a story, he asked for the student manager.

"I understand," he said, "that you carry a chaplain to pray for the team."

"Yes, sir, that's right."

"Would you mind introducing me to him?"

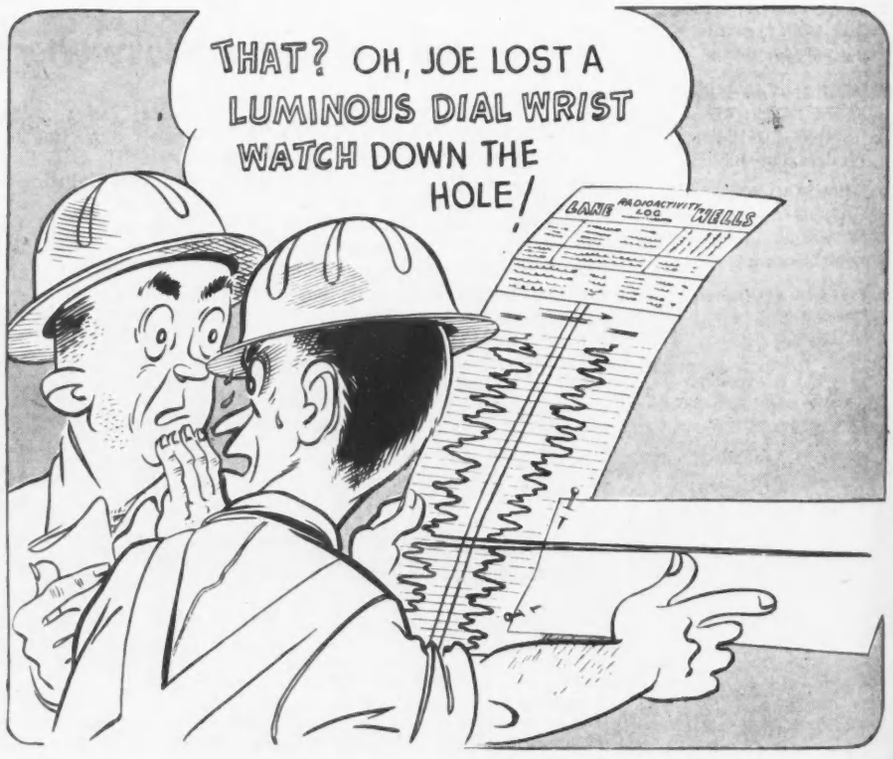
"Be glad to. Which one do you want, the offensive chaplain or the defensive?"

Grounded

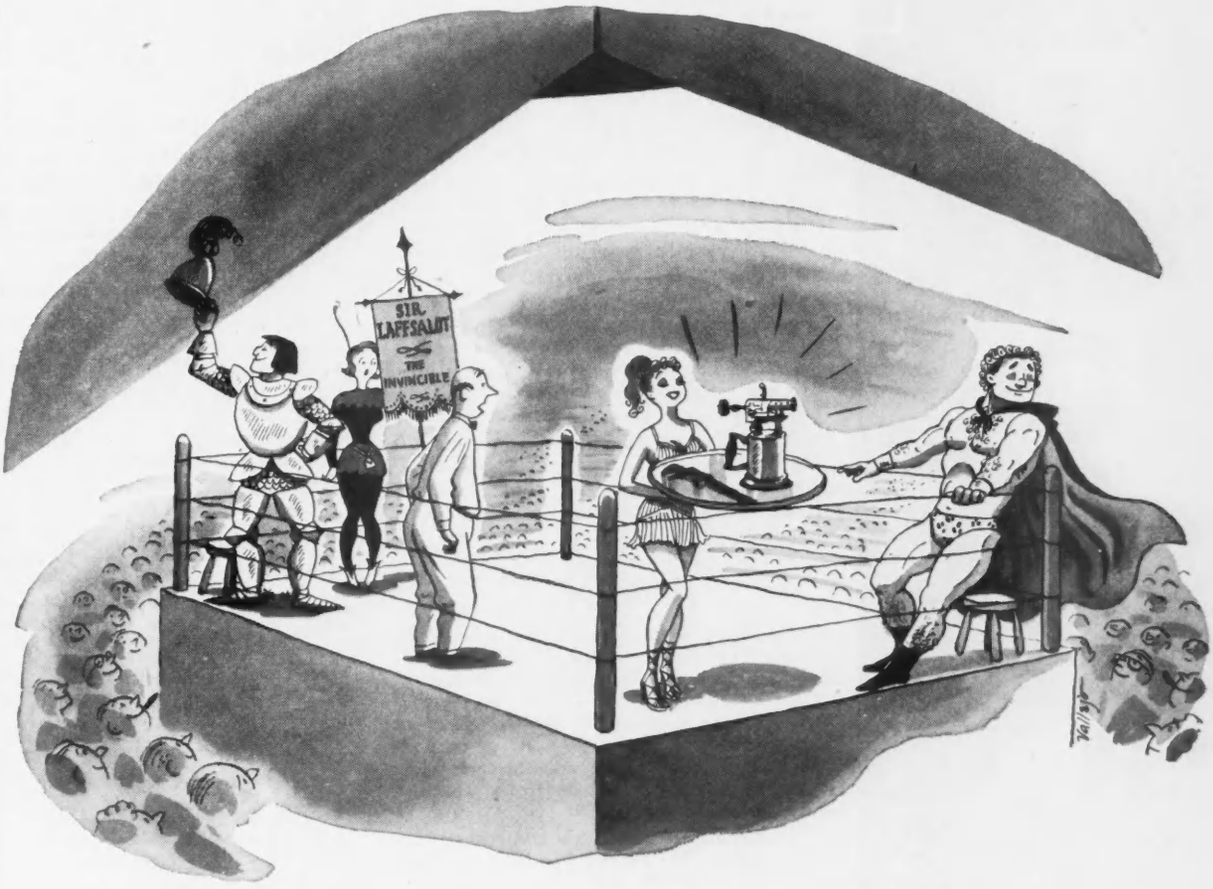
Motorist: "How far is it to the next town?"

Farmer: "About five miles as the crow flies."

Motorist: "Well, how far is it if the damned crow has to walk and carry a gasoline can?"



Steel Problems?



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GRAPPLING with a really rough steel problem? Don't let it throw you. Just call Jorgensen. Jorgensen's long experience will help you pin down the one *right* steel. And nearby Jorgensen warehouses make it easy to get your hands on almost any steel—carbon, alloy, stainless, tool or specialty. Come out on top. For steel—*CALL JORGENSEN FIRST!*

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SQUEAKS FROM THE BULLWHEEL

What the Doctor Ordered

The doctor met Mrs. O'Hoolihan at the door. "Did you take your husband's temperature as I told you? And how is he?"

"I did that, you know, Doctor. I borrowed a barometer and placed it on his chest. It read Very Dry so I rushed out and brought him a barrel of beer. He's gone back to work today."

Hour of Decision

Johnson had obtained work at a pipe line yard and was told to mark some trucks.

"Here's a piece of chalk," said the foreman. "Mark each of 'em eleven."

A little later the foreman came around again to see how the new hand had been getting on. He found him sitting on a bucket regarding a truck thoughtfully. Marked upon it was a large "1."

"What does this mean?" asked the foreman. "Only one truck done, and the number wrong at that. I said eleven, not one."

"I know," said Johnson, "but I couldn't think on which side of the '1' the other '1' goes!"

Law of the Land

Two men were working on the White House lawn, each supplied with a small push cart upon which was a garbage can. They walked about picking up papers with a long spear. One spied a piece of tissue and started to spear it, when suddenly a gust of wind came up and blew the paper into the White House through an open window.

The man became frantic and rushed into the building. He returned shortly after and said: "I was too late. He had already signed it."

Libelous Label

"What's the matter?" a cohort asked a raging salesman.

"Matter?" he sputtered. "My boss called me a model salesman, so I looked up the word 'model' in the dictionary. It said, 'a small imitation of the real thing!' "

Retribution

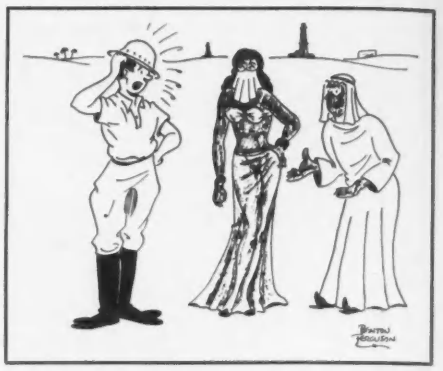
The young man who was throwing away his life (and his money) on strong drink received a call from his worried father. The father took the young man to the top of the hill overlooking Lexington, Ky.

"Look down there at those lights," said the father. "Those are distilleries. Men down there are working to make you fritter away your money. They are making whiskey . . . more than you can drink. Try to get that into your head."

The young man looked down into the valley, thought a minute, then replied: "Well, anyway, I've got 'em working nights."

Duty First

The cute customer approached the floorwalker and asked, "Do you have notions on this floor?" And the floorwalker replied: "Yes, madam, but we must suppress them during business hours."



"Frankly, Ahmed, I don't think our lease department has ever handled a deal like this."

Ladies' Day

It's a woman's world. When a man is born people say, "How is the mother?" When marries, they say, "What a lovely bride!" And when he dies they say, "How much did he leave her?"

Battle of the Sexes

We just heard about a fellow who received a broken arm fighting for a woman's honor . . . it seems that she wanted to keep it.

Auld Lang Syne

She: "You seem to be the kind of a fellow a girl can trust."

He: "Haven't we met before? Your faith is familiar."

The Last Word

The office skeptic says that marriage is an institution which teaches a man thrift, regularity and many other splendid virtues he wouldn't need if he stayed single.

There is also considerable wisdom in the words of a small boy writing answers to an anatomy test: "Your legs is what if you ain't got two pretty good ones, you can't get to first base, and neither can your sister."

Standco
NO-SMOKE
STANDCO BRAKE LINING
Stands the gaff and gets the job done without scoring brake rims. See pages 3973-3978, Composite Catalog.
Standco Brake Lining Co.
HOUSTON

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..IT'S PELCO TOO!